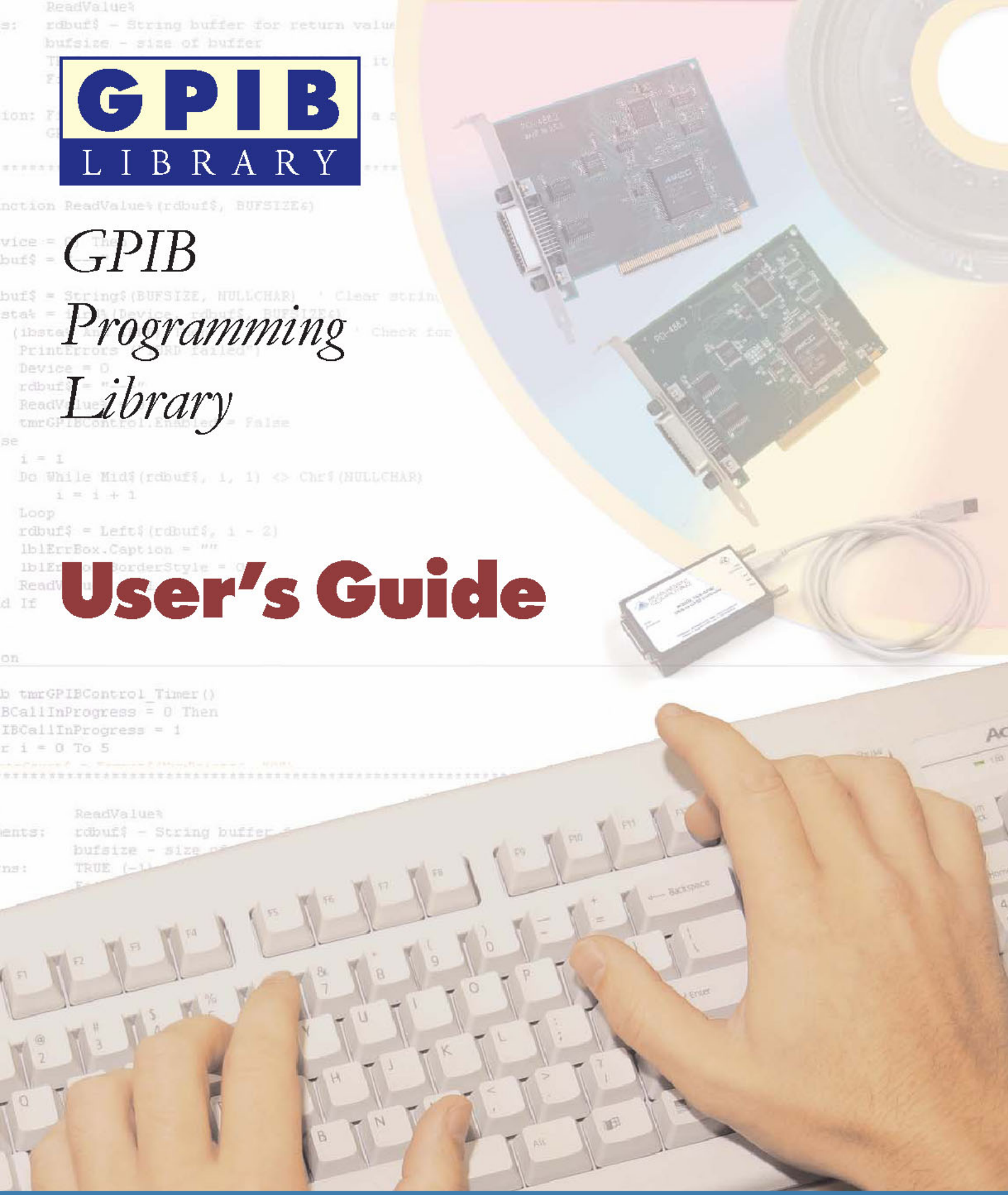
GPIB
LIBRARY

# GPIB Programming Library

# User's Guide



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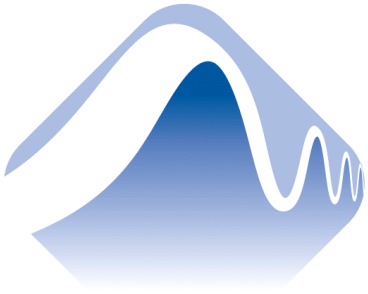
# GPIB Library Software

## User's Guide



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# Preface

## Definition of terms

GPIB terms used within this manual are listed here:

**GPIB** General Purpose Interface Bus

**System controller** The system controller has the unique ability to retrieve active control of the bus or to enable devices to be remotely programmed. It takes control of the bus by issuing an `IFC` (Interface Clear) message for at least 200 µsec. It also can put devices into the remote state by asserting the `REN` (Remote Enable) line.

There is always one system controller in a GPIB system. The system controller is designated at system initialization either through the use of hardware switches or by some type of configuration software, and is not changed. The system controller can be the same controller as the one which is the current active controller or an entirely different one. Note that if a controller is both a system controller and the active controller and it passes control to another controller, the system controller capability is not passed along with it.

**Active controller** The active controller is the controller which has the ability to mediate all communications which occur over the bus. In other words, the active controller designates (addresses) which device is to talk and which devices are to listen. The active controller is also capable of relinquishing its position as active controller and designating another controller to become the active controller.

**Device** A device is any IEEE-488 instrument which is not a system controller or active controller. It can be idle or act as a talker and/or listener when addressed or unaddressed by the active controller.

**Listener** A listener is any device which is able to receive data when properly addressed. There can be up to 14 active listeners on the bus concurrently. Some devices can also be a talker or controller; however, only one of these functions can be performed at a time.

**Talker** A talker is a device which can transmit data over the bus when properly addressed. Only one device can transmit at a time. Some devices can also be a listener or controller; however, only one of these functions can be performed at a time.

## Conventions used in this manual

The following typographical conventions are used within this manual.

[key] Text enclosed in brackets indicates a key on the keyboard to press.

**bold** text **Bold** text indicates a menu selection.

*Italic* text *Italic* text indicates the name of a manual, and to emphasize a word or phrase.

`monospace` text `Monospace` courier text indicates code, programming examples, and syntax examples.

**For more information on …**

Text presented in a box is used to signify additional information and helpful hints related to the subject matter you are reading.

**Caution!** Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

# Overview – GPIB Software (16-bit and 32-bit)

The MCC GPIB software includes the 488.1 library, the 488.2 library, and a set of utility programs. Each library is modeled on a corresponding National Instruments™ library.

- The 488.1 library consists of all of the functions and subroutines that begin with the letters "ib" (or "il"). The 488.1 library routines refer to devices on the GPIB bus by their device names and handles rather than by their GPIB addresses.
- The 488.2 library consists of all the routines that do not begin with the letters "ib", or "il" for Basic. The 488.2 library routines refer to devices on the GPIB bus by their GPIB addresses rather than by their names or handles.

The GPIB library is available in both a 16-bit and a 32-bit version.

## Supported languages

The GPIB library provides identical routines for each supported language. Languages supported by the GPIB library at the time this manual was published are listed below. Both 16-bit and 32-bit versions are supported where applicable.

| Microsoft Windows Languages | Borland Windows Languages |
|---|---|
| ▪ Visual Basic | ▪ Borland C/C++ (Windows) |
| ▪ Visual C/C++ | ▪ Borland C/C++ |
| | ▪ Delphi |
| **Microsoft DOS languages** | **Borland DOS Languages** |
| ▪ QuickBASIC | ▪ Borland C |
| ▪ Professional BASIC | ▪ Turbo Pascal |
| ▪ Visual Basic for DOS | |
| ▪ Microsoft C | |

The GPIB software is available in 16-bit and 32-bit packages. The two packages provide essentially the same capabilities. However, the 32-bit package is not available for DOS or Windows 3.1, while the 16-bit package is not available for Windows 2000, Windows XP, and Windows NT. New users are encouraged to use the 32-bit package, as it has wider applicability in more recent PC environments and with more 3rd party packages.

## GPIB library utility programs

The following utility programs are installed with the 16-bit and 32-bit GPIB library software.

| Utility program | Description |
|---|---|
| CBCONF.EXE | GPIB configuration program (DOS/Win16) |
| CBTEST.EXE | Hardware test program (DOS/Win16) |
| CBIC.EXE | Interactive control program (DOS/Win16) |
| CBCONF32.EXE | GPIB configuration program (Win32) |
| CBTEST32.EXE | Hardware test program (Win32) |
| CBIC32.EXE | Interactive control program (Win32) |

# Operating system support

Table 1-1 lists the operating systems supported by the 16-bit and 32-bit GPIB library software.

Table 1-1. 16-bit vs. 32-bit version support

| GPIB software | DOS | Win 3.1 | Win 95 | Win 98/ME | Win 2000/XP | Win NT |
|---|---|---|---|---|---|---|
| 16-bit package | Yes | Yes | Yes | Yes | No | No |
| 32-bit package | No | No | Yes | Yes | Yes | Yes |

**The GPIB library supports installation of two GPIB boards**

Each version of the GPIB library provides support for two GPIB boards.

## Support for VISA calls

Visa (Virtual Instrument Software Architecture) drivers are command drivers that convert company and program-independent VISA calls into company-dependent calls. VISA function calls are compatible with MCC's GPIB 488.2 controller products when used with a National Instruments VISA driver.

## GPIB-32.dll function support

Each library function defined by GPIB 488.1 and GPIB 488.2 has a corresponding entry point in `gpib-32` dll.

### Multithreading

The GPIB library does not support multithreading. If your GPIB application calls into the DLL from multiple threads, modify the application so that it calls into the DLL from a single thread. You do not need to remove the functions `ThreadIbcnt`, `ThreadIberr` and `ThreadIbsta` from the application, since these functions are implemented in the MCC GPIB-32.dll for a single thread.

### IBNotify

The GPIB library does not support `ibnotify`. Applications that utilize the `ibnotify` function will not run properly.

# Installing, Configuring, and Testing the GPIB Library

## Overview

The procedure to install the GPIB library software is dependent on your operating system and whether you are installing the 16-bit or the 32-bit version of the library.

When you install the GPIB-32 library on Windows XP, Windows 2000, Windows NT, and Windows 98/ME, the setup program installs a file named gpib-32.dll on your system. If a gpib-32.dll file is detected on your system, it is renamed to gpib-32.old.

When you install the GPIB-16 library on Windows 98/ME, Windows 95, and Windows 3.1, the setup program installs a file named gpib.dll file on your system. If a gpib.dll file is detected on your system, it is renamed to gpib.old.

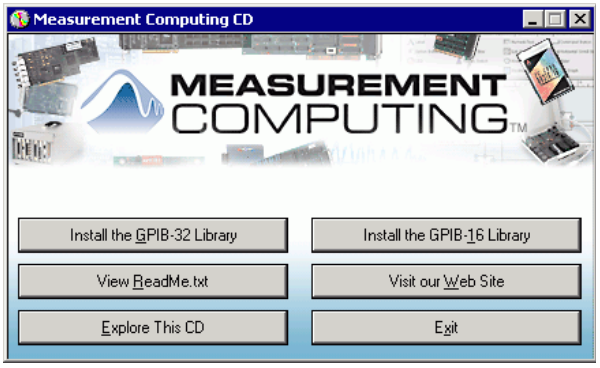
## Installing the GPIB library software for Windows

To install the MCC GPIB library, do the following:

1. Insert the installation CD into your CD drive.

   If you have the auto-run feature enabled on your computer, the installation starts automatically. If the auto-run feature is not enabled, use Explorer to navigate to the root of the CD drive, and double-click on the `SETUP.EXE` file.

   The **Measurement Computing CD** dialog appears.




2. Click on "**Install the GPIB-32 Library**" to install the 32-bit package, or click on the "**Install the GPIB-16 Library**" to install the 16-bit package.

   You are prompted to select the directory where you want to install the library software. By default, the 32-bit library is installed in the `C:\GPIB_32` directory, and the 16-bit library is installed in the `C:\GPIB` directory.
3. Follow the on-screen instructions. The dialogs that appear vary according to your operating system.

# Installing the 16-bit GPIB library for DOS

To install the 16-bit DOS version, do the following.

1. At the command prompt, type the following:

   `x:\product\disk2\INSTALL.BAT [ENTER]`

   `Where x` is the drive letter of the installation CD, and `[Enter]` is the "Enter" key.

   `INSTALL.BAT` is a batch file that creates a directory called `C:\CBI_GPIB` and a set of subdirectories for each programming language.
2. Follow the on-screen instructions.

After you install the software, do the following

1. Edit your `AUTOEXEC.BAT` file to include the line:
   `SET GPIBDIR=<your install directory path>`
2. If you are going to use the `GPIB DOS` device driver, edit `CONFIG.SYS` to include the line:
   `DEVICE=<your install directory path>\CBGPIB.COM`
3. Reboot the computer.

# Configuring your hardware with CBCONF

Use the `CBCONF` hardware configuration utility to configure your MCC GPIB board type and related interface parameters. When using 488.1 routines, you may need to run the `CBCONF` program to set specific GPIB device parameters. When installed with the 32-bit library, `CBCONF` is named `CBCONF32`.

Use `CBCONF` to change the default configuration parameters for the GPIB interface board(s) and the GPIB devices connected to it. Most recent third party packages do not require that you set specific device options as they perform this configuration at runtime. However, you still need to configure your GPIB interface board.

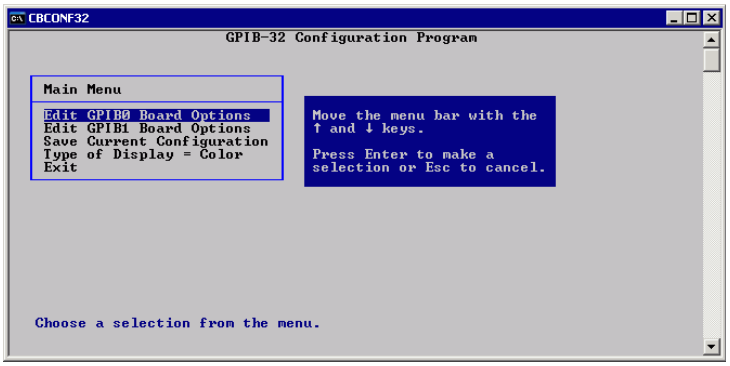
You can change any parameters to meet the needs of your application and save them to the configuration file. When you run a GPIB application, the library reads the contents of the `GPIB.CFG` configuration file.

- To run `CBCONF` from Windows, click on **Start** > **Programs** > **GPIB-32 Library** > **CBCONF** (`CBCONF32` for the 32-bit package).
- To run `CBCONF` from DOS, type `CBCONF` from the DOS command line prompt.

The Main Menu appears.

**Differences between the 16-bit CBCONF and the 32-bit CBCONF32 utility programs**

The following dialogs appear when you run the 32-bit `CBCONF32` utility. In most cases, the dialogs, options, and default values are the same for the 16-bit `CBCONF` utility.


CBCONF32
GPIB-32 Configuration Program
Main Menu
Edit GPIB0 Board Options
Edit GPIB1 Board Options
Save Current Configuration
Type of Display = Color
Exit
Move the menu bar with the ↑ and ↓ keys.
Press Enter to make a selection or Esc to cancel.
Choose a selection from the menu.

Use the up and down arrow keys to highlight your selection and press [Enter]. To cancel your selection, press [Esc]. When running in Windows, you can click on an item with your mouse.

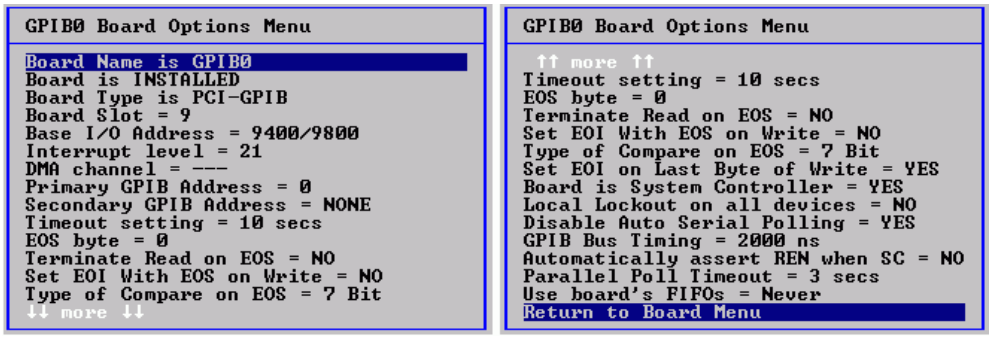
## Board options

To view or edit the options for a GPIB board, select **Edit GPIB0 Board Options** or **Edit GPIB1 Board Options**. The menu for the selected GPIB board appears. The **GPIB0 Menu** is shown here.

Use the up and down arrow keys to highlight your selection and press [Enter]. To cancel a selection, press [Esc]. When running in Windows, you can click on an item with your mouse. Other keys are used as follows.

| | |
|---|---|
| [Home] | Selects the first device in the list. |
| [End] | Selects the last device in the list. |
| [PgUp] [PgDn] | Changes between device list pages |

To view the board options for GPIB0, select **GPIB0 Board Options**. The **GPIB0 Board Options Menu** appears. An example of the board settings for a PCI-GPIB board is shown here.


GPIB0 Board Options Menu
Board Name is GPIB0
Board is INSTALLED
Board Type is PCI-GPIB
Board Slot = 9
Base I/O Address = 9400/9800
Interrupt level = 21
DMA channel = ---
Primary GPIB Address = 0
Secondary GPIB Address = NONE
Timeout setting = 10 secs
EOS byte = 0
Terminate Read on EOS = NO
Set EOI With EOS on Write = NO
Type of Compare on EOS = 7 Bit
↓↓ more ↓↓
GPIB0 Board Options Menu
↑↑ more ↑↑
Timeout setting = 10 secs
EOS byte = 0
Terminate Read on EOS = NO
Set EOI With EOS on Write = NO
Type of Compare on EOS = 7 Bit
Set EOI on Last Byte of Write = YES
Board is System Controller = YES
Local Lockout on all devices = NO
Disable Auto Serial Polling = YES
GPIB Bus Timing = 2000 ns
Automatically assert REN when SC = NO
Parallel Poll Timeout = 3 secs
Use board's FIFOs = Never
Return to Board Menu

Descriptions of each board setting are listed in Table 2-1.

If you are installing the GPIB board for the first time, check the values of the following board settings before running a GPIB application.

- Board type
- Base I/O address
- Interrupt level
- DMA channel (not applicable in all cases)

Depending on the GPIB board you are installing, you may have to set one or more of these options. Refer to the *GPIB Hardware User's Manual* that was shipped with your board for details about configuration settings that you must set for your board.

Table 2-1. CBCONF board options

| Board option | Description |
|---|---|
| `Board Type` | The GPIB library supports a number of different types of GPIB boards. The choice selected here must match the board that you have installed. If not, the library generates an `ECFG` error (error code = 252). Refer to the *GPIB Hardware User's Manual* that came with your board (or the board itself) to determine the board type.<br>▪ Install a PC2A board as either `ISA-CIO-PC2A` or `ISA-GPIB-PC2A`. If you have just purchased the board, select `ISA-GPIB-PC2A`. If you are updating software for a CIO-PC2A board purchased before 1997, select `ISA-CIO-PC2A`.<br>▪ Install a PCI-GPIB-300K or PCI-GPIB-1M board as `PCI-GPIB`.<br>If you are not sure of your board type, select a board type from the menu. The `CBTEST` program will detect if it is not correct |
| `Board Slot` | Some GPIB boards (PCI-GPIB and PCM-GPIB) are configured based on the slot number that they are plugged into. For these boards, `Board Slot` is the slot number that the board is currently plugged into.<br>This menu item is set automatically by the configuration program. If you install more than one board, the library uses the slot number to differentiate them. |
| `Base Address` | The base I/O address that the board is configured for.<br>Set the board address so that it does not conflict with another board installed in the system. When more than one GPIB board is installed, set each to a different base address.<br>On some boards (ISA-GPIB, ISA-GPIB/LC, PC2A) the base address is set with switches on the board. Refer to the board's *GPIB Hardware User's Manual* for details. When you change the address switches, you must also change this software configuration. The boards are factory set to the default base address. In typical installations, this default address can be used. You may have to change the address to prevent conflicts with other boards in your system.<br>**Important**: For proper operation, the switch settings for base address on the board must match the base address setting in `CBCONF`. |
| `Interrupt Level` | The hardware interrupt (IRQ) line that the board is configured for.<br>Configure the board's interrupt level so that it does not conflict with any other board that is installed in the system. If you have more than one GPIB board installed, set them to different interrupt levels.<br>On some GPIB boards, the interrupt level is controlled entirely by this selection on `CBCONF`'s Board Options menu.<br>**Important**: Some boards (PC2A) have switches and jumpers on the boards that must be changed any time you change the Interrupt Level.<br>Refer to your board's *GPIB Hardware Manual* for details about setting the Interrupt Level of your board. |
| `DMA Channel` | The DMA channel that the board is configured for.<br>The board should be configured for a DMA channel that does not conflict with any other board that is installed in the system. If you have more than one GPIB board installed they must be set to different DMA channels.<br>Some GPIB boards do not use DMA. When those board types are selected, the DMA Channel option is disabled. Other GPIB boards (PC2A and ISA-GPIB/LC) can use a DMA channel for high speed operation. The software comes from the factory set for DMA Channel 3. If you know that another board in your system already uses this DMA Channel then select a different channel or set the DMA Channel=NONE to disable DMA operation.<br>**Important**: Some boards (PC2A) have jumpers on the boards that must also be changed, any time you change the DMA Channel.<br>Refer to your board's *GPIB Hardware User's Manual* for details about setting the DMA Channel of your board. |
| `Primary GPIB Address` | Each GPIB device must have a unique bus address. This choice let's you set the board's address (0 through 30). Set the GPIB board to an address that does not conflict with any other device on the GPIB bus. |
| `Secondary GPIB Address` | GPIB devices can use extended addressing to increase the number of addresses that can be supported on a single bus. This choice let's you set the board's secondary address. The default setting is `NONE`, which disables extended addressing for the board. |

| Board option | Description |
|---|---|
| Timeout Setting | The amount of time that each I/O function waits for data before giving up and returning an EABO error. The default timeout is 10 seconds. For longer operations, for example when you transfer a very large mount of data, you may have to increase the Timeout Setting. Refer to Table 4-5 "Timeout codes" on page 77. |
| EOS Byte | There are two methods for devices to indicate the last byte in a transfer of multiple bytes.<br>▪ The most common method is for the sending device to assert the EOI line before sending the last byte. This method is automatically supported by the GPIB library.<br>▪ The second method involves sending an extra End-Of-String (EOS) character to indicate the end of data. A common EOS Byte is the linefeed character (decimal 10). In most cases, you do not have to set the EOS Byte since most devices rely on the EOI line instead. The default value for EOS Byte is 0. |
| Terminate Read On EOS | Some devices signal the last byte of a transfer by sending an EOS byte. When set to YES, all read operations automatically terminate whenever the EOS byte is received. If you set this option to YES, you must also set the EOS Byte (described above). The default value for this choice is NO. In most cases, it will never need to be set to YES. |
| Set EOI With EOS on Write | If you set this option to YES, all write operations automatically assert the EOI line whenever the EOS byte is transmitted. If you set this option to YES, be certain to also set EOS Byte (described above). The default value for this choice is NO. In most cases, it will never need to be set to YES. |
| Type of Compare on EOS | This option controls whether checks for the EOS byte use a 7 or 8 bit compare. This option has no affect unless Terminate Read On EOS or Set EOI With EOS on Write is set to YES. |
| Set EOI on Last Byte of Write | When set to YES, the library automatically asserts the EOI line before sending the last byte in a series of bytes. This is the most common method of signaling the end of a transfer. The default for this option is YES. Do not set to NO unless all devices that the board communicates with use an EOS byte instead. |
| Board is the system controller | There should always be one (and no more than one) system controller in a GPIB system. Ordinarily the board is the system controller, so the default value for this option is YES. If there are multiple boards or multiple computers attached to the GPIB system, configure one of them as system controller, and set the others to NO. |
| Local Lockout On All Devices | This option determines whether GPIB devices are automatically locked out of local operation whenever they're being programmed remotely by this board. The default setting is NO. |
| Disable Auto Serial Polling | This option enables/disables automatic serial polls whenever any device asserts the SRQ line. The default choice is YES, which disables the auto serial poll. |
| Bus Timing | This option sets the T1 handshaking delay that the board uses to send data over the bus. This delay is part of the IEEE 488.2 specification. The default value is 500 ns. If the total length of all GPIB cables in your system is less than 15 meters, then the T1 delay can be set to 350 ns (except on PC2A boards). |
| Automatically Assert REN When SC | This option controls whether the Remote Enable (REN) line is asserted whenever the board is in use. The default choice is YES. If it is set to NO, the only time REN is asserted is when it is explicitly set with the ibsre or RemoteEnable routines. |
| Parallel Poll Timeout | This option controls how long the library waits when doing a parallel poll before reading the data from the bus. The default setting is 2 µsec. In some cases, if you are using a bus extender it may be necessary to increase the delay to 10 µsec. |
| Use Board's FIFOs? | This option controls whether the library utilizes the FIFOs on those boards which have FIFO capability. The FIFOs can enhance performance on those applications which transfer large volumes of data. There are three options: NEVER, WHERE APPROPRIATE and ALWAYS. We recommend that you first get your application running without the FIFOs and then later enable them to see if there is any performance improvement. |

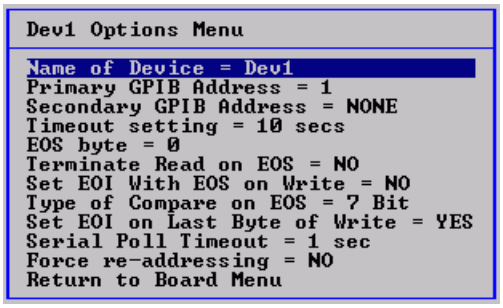
## Device options

There are many device options that can be set from the Device Options menu. Each option is associated with a single device on the bus. These options are in effect when doing device level (rather than board level) I/O. For example:

```
board = ibfind ("GPIB0");
dev = ibfind ("VoltMeter");
ibwrt (board,"ABC",3);        // Board level options in effect
ibwrt (dev,"ABC",3);          // VoltMeter devices options in effect
```

To view or edit the options set for a GPIB0 device connected to GPIB0, select **Dev1 Device Options** from the GPIB0 Menu.

The **Dev1 Options Menu** appears. An example of this menu is shown here.


Dev1 Options Menu
Name of Device = Dev1
Primary GPIB Address = 1
Secondary GPIB Address = NONE
Timeout setting = 10 secs
EOS byte = 0
Terminate Read on EOS = NO
Set EOI With EOS on Write = NO
Type of Compare on EOS = 7 Bit
Set EOI on Last Byte of Write = YES
Serial Poll Timeout = 1 sec
Force re-addressing = NO
Return to Board Menu

Descriptions of each device option are listed in Table 2-2.

Table 2-2. CBCONF device options

| Option name | Description |
|---|---|
| `Name of Device` | The name to associate with a device at a particular address. This name is passed to the `ibfind` routine when you want to get a handle for communicating with that device. |
| `Primary GPIB Address` | The device's primary address. Each GPIB device must have a unique address. Typically the address of a GPIB device is set by switches on the device. This option lets you specify the bus address of the device for communicating with the GPIB interface. |
| `Secondary GPIB Address` | The device's secondary address. Some GPIB devices use extended addressing to increase the number of addresses that can be supported on a single bus. The default is `NONE`, which indicates that the device is not using extended addressing. |

| Option name | Description |
|---|---|
| Timeout Setting | Timeout Setting is the amount of time that each I/O function waits for data when communicating with this device. If the device does not respond within the specified period, it gives up and returns an EABO error. The default timeout is 10 seconds (10 secs). In cases where it is expected that an operation takes longer (transfer of a very large mount of data, for example) you may have to increase the Timeout Setting. |
| EOS Byte | There are two methods for devices to indicate the last byte in a transfer of multiple bytes. The most common method is for the sending device to assert the EOI line before sending the last byte. This method is automatically supported by the GPIB library.<br>The second method involves sending an extra End-Of-String (EOS) character to indicate the end of data. A common EOS Byte is the linefeed character (10). In most cases, you will not need to set the EOS Byte since most devices rely on the EOI line instead. The default value for the EOS Byte is 0. Note: You cannot use EOS with the FIFOs enabled. |
| Terminate Read On EOS | Some devices signal the last byte of a transfer by sending an EOS byte. If you set this option to YES, all read operations with this device automatically terminate whenever the EOS byte is received. If you set this option to YES, be certain to also set EOS Byte (described above). The default value for this choice is NO. In most cases, it will never need to be set to YES. |
| Set EOI With EOS on Write | If you set this option to YES, all write operations with this device automatically assert the EOI line whenever the EOS byte is transmitted. If you set this option to YES, be certain to also set the EOS Byte (described above). The default value for this choice is NO. In most cases, it will never need to be set to YES. |
| Type of Compare on EOS | Controls whether checks for the EOS byte use a 7 or 8-bit compare. Has no affect unless you set Terminate Read On EOS or Set EOI With EOS on Write to YES. |
| Set EOI on Last Byte of Write | When set to YES, the library asserts the EOI line before sending the last byte in a series of bytes. This is the most common method of signaling the end of a transfer. The default is YES. Do not set to NO unless the devices uses an EOS byte instead. |
| Serial Poll Timeout | This option controls how long the library waits when doing a serial poll before it gives up. The default setting is 1 sec. If the serial poll with this device returns an EABO error, try increasing this value. |
| Force re-addressing | Determines whether the device is specifically addressed on each access.<br>When set to NO, once the device is addressed for either listen or talk, all subsequent access to the device is done without sending the addressing command if the access type matches the addressing. For example, if a particular device is read five times (with no intervening write), only the first read includes the "address to talk" command. When Force re-addressing is set to YES, every access to the device includes the appropriate addressing command. The default setting for this option is NO. |

## Setting board names, device names and addresses

You can use CBCONF to assign a name to each device on your GPIB bus. The initial configuration lists 16 devices (Dev1 - Dev16) connected to each GPIB board. Each name is associated with a unique GPIB address. By default, "Dev1" is set for address 1, "Dev2" = address 2, etc. You can keep these default names and your programs can refer to "Dev1" or "Dev2". In that case, you are in effect still referring to the devices by addresses.

You can also enter a meaningful name for each device that is independent of its address. For example, if you have a voltmeter at address 4 and a signal generator at address 7 on your bus, edit the name and address of each device as follows.

1. From CBCONF's Main Menu, select "**Edit GPIB0 Board Options**".

   Device names are listed at the bottom of the GPIB0 Menu as **Dev1** - **Dev16**.
2. Select "**Dev1 Device Options**".

   The **Dev1 Options Menu** appears.
3. Select "**Name of Device**" and press [Enter].
4. At the prompt, type in "**VoltMeter**" and press [Enter].

The menu title changes to **VoltMeter Options Menu**.

5. Select "**Primary GPIB Address**" and press [Enter].
6. At the prompt, type in "**4**" and press [Enter].

Repeat this procedure to change the name of Dev2 to **SigGen** and the address to **7**. After the system is configured with these names, you can write a program that communicates with devices called **VoltMeter** and **SigGen**. The program does not reference any GPIB addresses.

If you change the address of either device, you do not have to change the program. Rerun `CBCONF` and change the address that is associated with the device name.

After configuring the board, you should test the communication between your GPIB board and device(s). Refer to Testing your GPIB hardware with CBTEST below for instructions.

## Testing your GPIB hardware with CBTEST

`CBTEST` is a quick-test program that verifies that the GPIB board is installed and configured correctly. `CBTEST` displays the current hardware configuration (board type, base address, interrupt level, DMA channel) that you selected with the `CBCONF` program. When installed with the 32-bit library, `CBTEST` is named `CBTEST32`.

`CBTEST` checks that the software and hardware configurations match, and that the hardware is working. If it reports any problems, verify that the switch and jumpers settings on the board, if any, are correct and that they match those shown in the `CBCONF` program.

## Testing communication with GPIB devices with CBIC

`CBIC` is an interactive program that lets you type GPIB commands and execute them immediately rather than writing a program. Before you write your first GPIB program, practice with the `CBIC` program. `CBIC` lets you verify the device addressing, cabling, and proper commands for the instruments that you are using. When installed with the 32-bit library, `CBIC` is named `CBIC32`.

**Find/Set Device Addresses** — You should know the GPIB addresses that your GPIB devices are configured for. If not, refer to the device's User Manual for instructions on how to set the GPIB address. Set each instrument to a different address. The default address for the GPIB board is 0. Do not set any device to address 0 unless you have changed the board address.

**Plug in GPIB cables** — Connect the GPIB board to the device with a standard GPIB cable. Connect one end to your GPIB board, and the other end to the GPIB device. If you have more than one GPIB device, "daisy-chain" the cables between them.

**Find List of Device's GPIB Commands** — Each GPIB device understands its own set of commands. For example, on a Fluke 45 Voltmeter you would send the command "`vac`" to select the volts AC range. On a different voltmeter you may have to send a different command to perform the same function. Refer to the device's user manual for a list of the GPIB commands supported by the device.

When you run `CBIC`, the program displays a copyright message followed by a ":" prompt.

To execute GPIB library routines, type the routine at the prompt. Refer to Chapter 4 GPIB 488.1 Library Reference on page 29, and Chapter 5 GPIB-488.2 Library Reference on page 87 for details on each library routine. You should perform the following `CBIC` tests to get you started, and to show you how to use the GPIB library and `CBIC` program. The tests may also identify common installation/configuration problems.

## Testing with 488.2 commands

At the ":" prompt, type the following command:

```
: ibfind gpib0
```

The prompt should change to "gpib0:"

### Finding the listeners on the bus

If you are using an ISA CIO-PC2A board (or older 488.1 PC2A board), skip to Sending a Command below.

Enter the FindLstn command at the gpib0: prompt. This routine searches the GPIB bus for listeners that are specified by an address list. It should print a list containing the addresses of all devices within the address list that you have connected to the GPIB board.

```
GPIB0: FindLstn
```

the program responds with the following prompt. Type each address followed by [Enter]. Press [Enter] again at end of list

```
Enter address:
```

Enter each GPIB address where you expect to find a device. For example, if you have three instruments attached to the GPIB bus that you think are at addresses 3, 4, and 5, you would respond:

```
Enter address: 3
Enter address: 4
Enter address: 5
Enter address:
```

The FindLstn function then checks the bus to see if any instruments respond at the specified addresses.

Responding Devices:

```
Device at address = 3
Device at address = 5
```

In this example, two devices were found - one at GPIB address 3 and one at address 5.

When you type FindLstn, check the addresses that are returned and make sure that they match the addresses that you believe your devices are set for. If not, check the address settings on those devices. If FindLstn returns an ECAP error, you are using a GPIB board which does not support the FindLstn routine, such as the ISA CIO-PC2A. Proceed to Testing with 488.1 commands on page 13.

### Sending a command

Refer to the list of GPIB commands that your device understands. Choose a command that should cause some visible response on the front panel of the device. That will vary depending on the instrument. Often, a command that selects a range has a visible indicator.

Use the GPIB library Send routine to send the command to the device. The Send routine in the GPIB library has four arguments. When calling any of the library routines from within CBIC, the program always sends the first argument (board or dev) automatically. The three other arguments for Send are address, data, and eotmode.

- Set address to the device's GPIB address.
- Data is the command string you wish to send.
- Set eotmode to DABend

There are two ways to execute a GPIB library routine within CBIC: You can type in the name of the routine and CBIC prompts you for each of the arguments. You can also type them in all on one line, separated by spaces. Here's an example of each method:

```
GPIB0: Send
   Enter address of device : 5
   Enter string to be written : vac
   Enter EOTMode (DABend, NULLend, or NLend) : DABend
GPIB0: Send 5 vac DABend
```

Using either method, the command "vac" is sent to the device. On a Fluke45 voltmeter, the "vac" command selects the Volts AC range. The front panel indicator switches to "VAC".

### On-line help

If you forget the arguments for a command, use CBIC's help function. Type help and the name of the GPIB library routine. For example: `GPIB0: help send`
For more general help, enter the word "**help**" by itself. You can then choose from a variety of topics.

### Receiving data from the device

Refer to the list of GPIB commands that your device understands. Find a command that returns data. It will vary depending on the instrument. On many instruments, you send a command to the instrument (with the Send routine) and it will send back a response which you can read with the GPIB library's Receive routine.

For example, if you send the Fluke 45 Voltmeter the command "VAL?", it will take a measurement and then send the result back over the GPIB bus. This sequence is executed with CBIC as follows:

```
GPIB0: Send 5 val? DABend
GPIB0: Receive 5 100 STOPend
Data: -1.345e1
```

The arguments for the Receive routine are:

| | |
|---|---|
| 5 | Address of the meter |
| 100 | Maximum number of characters to read |
| STOPend | Causes Receive to stop reading when it receives the End (EOI) signal |
| -1.345e1 | The reading returned by the meter. |

Some GPIB instruments work a bit differently. For example, the Fluke 8840 DMM always returns the most recent measurement whenever you call the Receive routine. This meter doesn't require that you ask for each measurement by Send'ing a command.

The Fluke 8840 meter works this way:

```
GPIB0: Receive 5 100 STOPend
Data: -1.345e1
```

To read it again, you could type the same Receive command. You can also use the CBIC "!" command. The "!" command executes the most recent command again.

```
GPIB0: !
Data: -1.347e1
GPIB0: !
Data: -1.422e1
```

## Testing with 488.1 commands

In the examples above you were using the 488.2 GPIB library routines. The 488.2 Library always passes a GPIB address or a list of addresses as an argument to the routines.

The 488.1 routines are simpler to use because they use the device information that was configured with the CBCONF program. For example, if you configured a device named voltmeter with the CBCONF program, you communicate with the device as follows:

```
: ibfind voltmeter
voltmeter:
```

The prompt changes to "voltmeter:" to indicate that it is now the current device.

The most common error that can occur at this point is that the device could not be found. The following message appears on the screen:

```
Cannot find a configured device named voltmeter.
```

There are two possible reasons for this — you either typed the name incorrectly, or you have not configured a device named "voltmeter" with the CBCONF program. Run CBCONF and check the name that you gave the device. Refer to Device Options on on page 8.

### Sending a command with ibwrt

The ibwrt routine in the 488.1 library performs the same function as the Send routine in the 488.2 library. They both send a command to a GPIB device.

ibwrt is simpler to use because it has fewer arguments. The Send arguments address (the device's GPIB address) and EOTmode (the termination method) are not required when calling ibwrt. These arguments are automatically read from "voltmeter" configuration information that was set in the CBCONF program.

To send the command "vac" to the device called "voltmeter", do the following:

```
voltmeter: ibwrt vac
```

### Receiving data from the device

Receiving data with the ibrd routine is also a bit simpler than with the 488.2 library's Receive routine. Once again, fewer arguments need to be passed because it uses the configuration information in the GPIB.CFG file that is created by the CBCONF program.

This example shows you how to read a measurement from a Fluke 45 meter:

```
voltmeter: ibwrt val?
voltmeter: ibrd 100          (100 is maximum characters to receive)
Data:  -1.345e1
```

At this point, you can begin exploring the operation of your GPIB devices. You can use the CBIC program to quickly experiment with your devices using ibrd and ibwrt (or Send and Receive) and get a good idea of what they do. You can also explore all of the other routines in both the 488.1 and the 488.2 Library by typing them in at the CBIC prompt.

Refer to Chapter 4 GPIB 488.1 Library Reference on page 29, and Chapter 5 GPIB-488.2 Library Reference on page 87 for details on each library routine. You can also enter "help" at the CBIC prompt to display information about each command.

# Programming with the GPIB Library

The GPIB library contains two different and complete GPIB libraries. Each library is modeled on a corresponding National Instruments library.

**Original 488.1 library —** the 488.1 library (also referred to as the *original library*), consists of all of the functions and subroutines that begin with the letters "`ib`" (or "`il`"). This library uses a concept of device names and handles rather than GPIB addresses when referring to GPIB devices. There are two advantages to this approach:

- The GPIB addresses of each device are not stored in the program, so the same program can run on different buses where the addresses of each device are different.
- The program can refer to each device with an intelligible name rather than a number (the GPIB address).

**488.2 library —** this library consists of all the routines that do not begin with the letters "`ib`", or "`il`" for Basic. These routines refer to all devices on the bus by their GPIB addresses rather than by names. The Device IO section on page 15 does not apply to the 488.2 library.

The GPIB library includes different routines that allow you to control the operations of the GPIB bus in a very specific manner. You may find the number of routines included in the GPIB library intimidating, however, in most applications you need to use only a small subset of these routines.

The routines are divided into two distinct libraries. All routines which begin with "ib" (or "il") are part of the "488.1" or "Original GPIB library." All other routines are part of the "488.2 library." You only need to use one or the other library. Each library provides a different method of performing the same tasks. The choice of which library to use is a matter of personal preference. Refer to Testing with 488.2 commands on page 11, and Testing with 488.1 commands on page 13 for information about choosing which library to use. If you use the original GPIB library, you can perform either Board Level or Device Level operations.

## General concepts

This section explains the difference between routines which use Device I/O and those which use Board I/O, the use of device handles, and the global variables used by the library routines.

### Device vs. Board I/O

The most typical GPIB operations are sending commands to a device attached to the bus and reading back responses. To do this, program the GPIB board to execute these steps:

1. Address the selected device as a Listener.
2. Send the secondary address if used.
3. Address the board itself as the GPIB Talker.
4. Send the command bytes to the device.
5. Read the response from the device.
6. Send the GPIB `Unlisten` (UNL) message.
7. Send the GPIB `Untalk` (UNT) message.

The original GPIB library interface is comprised of two different types of routines: Board I/O and Device I/O. These routines are described in Chapter 4 GPIB 488.1 Library Reference. You can program the board using either Board I/O routines or Device I/O routines to perform the sequence of operations outlined above.

The 488.2 library is all "Board I/O" in that you always supply the board ID and the device address. Refer to Chapter 5 GPIB 488.2 Library Reference on page 87.

## Device I/O

It is usually easier to use the Device I/O routines. Device I/O is very simple to use and understand. Device I/O routines are higher-level routines which conceal most of the underlying complexity of GPIB operations. These commands use the device names you assigned with `CBCONF`. The Device I/O routines automatically take care of all of the low-level details involving GPIB messages and addressing. For example, to accomplish the seven steps listed above, you use only three routines:

- `ibfind` — to open the device
- `ibwrt` — to send the instrument command
- `ibrd` — to read the data back from the device

## Board I/O

In comparison, the Board I/O routines are low-level routines. If you use them, you must understand how the GPIB operates in detail. Generally, the only time you need to use Board I/O is if it is impossible to perform the same operation using device I/O, such as passing control from one controller to another.

To perform the same task as the seven steps outlined in Device I/O vs Board I/O on page 14 (send a command to a device), you need to know the codes for the various forms of addressing and the codes for the GPIB `Unlisten` and `Untalk` commands.

Use the routines in this sequence:

1. `ibfind` — to open the board
2. `ibcmd` — to send the address of the talker and listener
3. `ibwrt` — to send the command to the device
4. ibrd — to read the data back from the device
5. `icbmd` — to send the Unlisten (UNL) and Untalk (UNT) commands

## Device handles

Most of the routines in the 488.1 library have a device handle as the first argument. The first GPIB call in your program is usually `ibfind`. This routine "opens" a board or device and returns a GPIB board or device handle. If you pass the name of a board (as assigned by `CBCONF`), it returns a board handle. Likewise, if a device name is passed, a device handle is returned. Some library routines only work with device handles, some only with board handles, and some with both.

**Configure the board and device names before writing a program**

You assign board/device names with the `CBCONF` configuration program. It is important that you run your configuration program and make any necessary changes before you write your application program.

### Global variables

The following global variables are used in all programming languages:

| | |
|---|---|
| `ibsta` | Status Word |
| `iberr` | Error Codes |
| `ibcnt,ibcntl` | Count Variables (short/long) |

The ibsta and iberr variables are briefly explained here. For additional information about ibsta, refer to Appendix B - IBSTA on page 119. For additional information about iberr, refer to Appendix C – IBERR on page 121.

For additional information about ibcnt and ibcntl, refer to the routines which return them.

### ibsta — the status word

Every library routine updates a status word (ibsta) which indicates the results of the last operation. Your application program can test each bit of this word and then take appropriate action. The ibsta variable is discussed further in Appendix B - IBSTA.

### iberr — the error variable

If a GPIB error occurs during a routine, its corresponding error code is returned into the variable iberr. Possible error codes and their meanings are listed in Appendix C – IBERR.

### ibcnt and ibcntl — count variables

These variables contain an integer which describes how many bytes were actually transferred during a read or write operation. ibcnt is an integer value (16-bits wide) and ibcntl is a long integer value (32-bits wide).

# Example programs

This section provides three example programs:

- The first program illustrates a GPIB application using the 488.2 library.
- The second program illustrates Device Level I/O with the 488.1 library.
- The third program illustrates and Board Level I/O with the 488.1 library.

When you install the software, example programs for C, Delphi, and Visual Basic are also installed into sub folders named c, delphi and vb.

You should run the CBIC program to execute specific library routines using your system configuration. This will help you understand what types of responses you will obtain.

## Example program 1: simple I/O with the 488.2 Library

This example illustrates a simple GPIB application. It sends command strings to a Fluke45 Multimeter to initialize it, select a measurement range and make a measurement. It reads the measurement back from the meter and prints it on the screen. It uses the following commands which are specific to the Fluke 45:

```
*RST    'Reset the meter
VDC     'Select Volts DC Range
VAL?    'Take a measurement and send it over the GPIB bus
```

The program assumes that the Fluke45 is set for GPIB address 3.

BASIC programming language

```
const METER_ADR = 3
const BOARD_NUM = 0
buffer$ = space$(100)
DevClear (BOARD_NUM, METER_ADR)
Send (BOARD_NUM, METER_ADR, "*RST", DABend)
Send (BOARD_NUM, METER_ADR, "VDC",DABend)
```

```
Send (BOARD_NUM, METER_ADR, "VAL?", DABend)
Receive (BOARD_NUM, METER_ADR, buffer$, 100, STOPend)
PRINT "Voltage = ";buffer$
```

C programming language

```
#define METER_ADR 3
#define BOARD_NUM 0

int Board;
char buffer[100];
DevClear (BOARD_NUM, METER_ADR);                 // Clear the meter
Send (BOARD_NUM, METER_ADR, "*RST", DABend);
Send (BOARD_NUM, METER_ADR, "VDC", DABend);
Send (BOARD_NUM, METER_ADR, "VAL?", DABend);
Receive (BOARD_NUM, METER_ADR, buffer, STOPend);
printf ("Voltage = %s\n", buffer);
```

## Example program 2: device I/O with the 488.1 library

This example performs the same operations as the example above. Instead of using the 488.2 Library it uses the original 488.1 GPIB library.

The following examples show a simplified program (no error checking) for reading a DC voltage measurement from the volt meter. The program assumes that the name "VoltMeter" has been assigned to the Fluke 45 (via the `CBCONF` program).

BASIC programming language

```
buffer$ = space$(100)
CALL ibfind ("VoltMeter", device%)  ' Open device
CALL ibclr (device%)                ' Clear the device
CALL ibwrt (device%, "*RST")        ' Reset meter
CALL ibwrt (device%, "VDC")         ' Select volts DC range
CALL ibwrt (device%, "VAL?")        ' Ask for current value
CALL ibrd (device%, buffer$)        ' Read current value
PRINT "Voltage = "; buffer$;
```

C programming language

```
int device;
char buffer[100];
device = ibfind ("Volt Meter");     /* Open device */
ibclr (device);                     /* Clear the device
ibwrt (device, "*RST");             /* Reset meter */
ibwrt (device, "VDC");              /* Select volts DC range */
ibwrt (device, "VAL?");             /* Ask for current value */
ibrd (device, buffer,100);          /* Read current value */
printf ("Voltage = %s\n" buffer);
```

## Example program 3: board I/O with the 488.1 library

Board I/O requires a more detailed understanding of the GPIB bus and commands. Your program must explicitly send all of the GPIB command codes to set up each GPIB operation. For example, you must set up the addressing for talker and listener, etc.

The following example performs the same operations as the Device I/O example while using Board I/O routines. You need to be familiar with both the device-specific commands and also the GPIB Multiline Interface Messages (for example MLA, MTA, etc.). The program assumes that the Fluke 45 meter is at GPIB address 13.

BASIC programming language

```
CALL ibfind ("GPIB0", board%)       ' Open board
CALL ibsic (board%)                 ' Send IFC message
CALL ibsre (board%, 1)              ' Turn on REN
command$ = chr$(&H11) + "-" + chr$(&H14) +"@"
CALL ibcmd (board%, command$)       ' LL0, MLA13, DCL, MTA0
CALL ibwrt (board%, "*RST")         ' Reset meter
CALL ibwrt (board%, "VDC")          ' Select volts DC range CALL ibwrt
CALL ibwrt (board%, "VAL?")         ' Ask for current value
command$ = "?" + "_" + "M" + " "
CALL ibcmd (board%, command$)       ' UNL, UNT, MTA13, MLA0
buffer$ = space$(100)
CALL ibrd (board%, buffer$)         ' Read current value
PRINT "Voltage = "; buffer$;
```

C programming language

```
int board;
char buffer[100], *command;
board = ibfind ("GPIB0");           /* Open board */
ibsic (board%);                     /* Send IFC message */
ibsre (board%,1);                   /* Turn on REN */
command = "\0x11\0x2d\0x14\0x40";
ibcmd (board%, command, 4);         /* LL0, MLA13, DCL, MTA0 */
ibwrt (board%, "*RST", 4);          /* Reset meter */
ibwrt (board%, "VDC", 3);           /* Select volts DC range */
ibwrt (board%, "VAL?",4);           /* Ask for current value */
command = "\0x3f\0x5f\0x4d\0x20";
ibcmd (board%, command, 4);         /* UNL, UNT, MTA13, MLA0 */
ibrd (board%, buffer);              /* Read current value */
printf ("Voltage = %s\n" buffer);
```

## Error checking

The above example programs do not include any error checking. In a real program, you should always check for errors after each call to the library. The easiest way to do this is to write one error checking/handling routine and call it after every call to the library.

The error reporting mechanism involves three global variables - `ibsta`, `iberr` and `ibcnt`. If an error occurred during a call to the library then the EERR bit in `ibsta` is set (to 1) and `iberr` will contain an error code. If the error code indicates that a DOS error occurred, then `ibcnt` contains the DOS error code.

The following examples show how to use error handling routines using BASIC and C languages.

### BASIC programming language

```
CALL ibwrt (device%, "*RST")  ' After each call to GPIB
Call CheckGPIBError           ' check for errors
SUB CheckGPIBError ()
   IF (ibsta% AND EERR) <> 0 THEN
      PRINT "*** ERROR -"
      SELECT CASE iberr%
         CASE EDVR
            PRINT "EDVR=DOS Error"
         CASE ECIC
            PRINT "ECIC=Board is not Controller In Charge"
         CASE ENOL
            PRINT "ENOL=No listener"
         CASE EADR
            PRINT "EADR=Address Error"
         CASE EARG
            PRINT "EARG=Invalid argument passed to library"
         CASE ESAC
            PRINT "ESAC=Board is not system controller"
         CASE EABO
            PRINT "EABO=I/O Operation terminated"
         CASE ENEB
            PRINT "ENEB=No GPIB board installed"
         CASE EOIP
            PRINT "EOIP=Background I/O already in progress"
         CASE ECAP
            PRINT "ECAP=Board missing required capability"
         CASE EFSO
            PRINT "EFSO=File system error"
         CASE EBUS
            PRINT "EBUS=Command error"
         CASE ESTB
            PRINT "ESTB=Status byte lost"
         CASE ESRQ
            PRINT "ESRQ=SRQ line is stuck on"
         CASE ETAB
            PRINT "ETAB=Table overflow"
      END SELECT
      IF iberr% = EDVR THEN PRINT "DOS Error Code=";ibcnt%
      IF ibsta% AND TIMO THEN PRINT "GPIB device timed out"
   END IF
END SUB
```

### C programming language

```
ibwrt (device, "*RST", 4);    /* After each call to GPIB */
CheckGPIBError();             /* check for errors */

void
CheckGPIBError (void)
{
if (ibsta & EERR)
   {
   printf ("*** ERROR -");
   switch (iberr)
      {
      case EDVR
         printf ("EDVR=DOS Error\n");
      case ECIC
         printf ("ECIC=Board is not Controller In Charge\n");
      case ENOL
         printf ("ENOL=No listener\n");
      case EADR
         printf ("EADR=Address Error\n");
      case EARG
         printf ("EARG=Invalid argument passed to library\n");
      case ESAC
         printf ("ESAC=Board is not system controller\n");
      case EABO
         printf ("EABO=I/O Operation terminated\n");
      case ENEB
         printf ("ENEB=No GPIB board installed\n");
      case EOIP
         printf ("EOIP=Background I/O already in progress\n");
      case ECAP
         printf ("ECAP=Board missing required capability\n");
      case EFSO
         printf ("EFSO=File system error\n");
      case EBUS
         printf ("EBUS=Command error\n");
      case ESTB
         printf ("ESTB=Status byte lost\n");
      case ESRQ
         printf ("ESRQ=SRQ line is stuck on\n");
      case ETAB
         printf ("ETAB=Table overflow\n"););
      }
   if (iberr == EDVR)
   printf ("DOS Error Code=%d\n", ibcnt);
```

```
    if (ibsta% & TIMO)
    printf ("GPIB device timed out\n");
    }
return;
}
```

# Programming language-specific information

The GPIB library is nearly identical in each of the supported languages. Each function is explained in Chapter 4 GPIB 488.1 Library Reference on page 29. The descriptions apply to all supported programming languages.

## Developing Programs for Visual Basic for Windows

The Visual BASIC interface combines support for both the 16-bit and 32-bit versions of Visual BASIC. If you are running Windows 3.x then you are using the 16-bit VB. If you are running Windows 95/98 then you may be running either the 16- or 32-bit version. Use VB's "Help","About Microsft Visual BASIC" menu choice to find out which it is.

The files that make up the Visual BASIC for Windows interface are listed here.

| GPIB Library Component | Used with 16-bit? | Used with 32-bit? |
|---|---|---|
| `GPIB.DLL` — the GPIB library | Yes | No |
| `GPIB-32.DLL` — 32-bit "thunk" layer DLL | No | See note |
| `GPIB-16.DLL` — 16-bit "thunk" layer DLL | No | See note |
| `GPIB-32.DLL` — 32-bit GPIB library | No | See note |
| `GPIB-16.BAS` — Visual BASIC (16-bit version) header file | Yes | No |
| `GPIB-32.BAS` — Visual BASIC (32-bit version) header file | No | Yes |
| `GPIBVXD.386` — Device driver, loaded by `\windows\system.ini` file | Yes | Yes |
| `NTGPIBDD.SYS` — Device driver for Windows NT/2000/XP | No | Yes |
| **Note**: If you are using the 32-bit GPIB library, then the only DLL is `GPIB-32.DLL`. If you are using the 16-bit library with a 32-bit VB program, then you can employ the 16-bit GPIB library together with the "thunk" layer DLLs [GPIB-16.DLL and GPIB-32.DLL.] | | |

**Sample Programs**

The example programs are installed by default in the `C:\GPIB_32\vb` directory (`C:\CBI_GPIB\vb` directory for the 16-bit library).

`vb16demo.mak` - for the 16-bit version of VB

`vb32demo.mak` - for the 32-bit version of VB

**Versions Supported**

Visual BASIC 3.0 and higher

**Header File**

All VB programs that use the GPIB library must also include `GPIB-16.BAS`, `GPIB-32.BAS` or `GPIB-32M.BAS` file in the project.

To add the file to a project, select "`File`" and then "`Add File`" from the VB menu. You could also select "`Project`" > "`Add Module`". Select the appropriate header file depending on which version of VB you're using, and which version of the National Instruments GPIB library that you wish to be compatible with. Refer to the list above. National Instruments has two different versions of their GPIB library (NI 488.2 and NI-488.2M) that have slight incompatibilities between them. We have included two different header files (`GPIB-32.BAS` and `GPIB-32M.BAS`) that are compatible with each version of the National Instruments Library.

**Special programming notes**

**Calling GPIB library via Windows Timers** — the GPIB library can only execute one function call at a time. Due to the nature of Windows and VB, you can easily write a program that will attempts to execute more than one library call at a time if you use VB's timers.

For example, you have a timer routine that reads a meter every second by sending an `ibwrt` followed by an `ibrd`, and you also have a button on a panel that sends a range change command to the meter. When the timer code calls a GPIB function, the library may yield to Windows while it waits for the GPIB bus. If you press the front panel button, another call into the GPIB library will occur before the first one has completed. This may cause hard-to-diagnose problems, since bytes from the two different commands would get intermixed on the GPIB bus. To prevent this problem, the library will stop the second call from executing, and return an `ESML` error (library calls running simultaneously).

To prevent these `ESML` errors from ocurring, prevent simultaneous calls from being executed. The easiest way to do this is with a "semaphore variable". The idea is that you have a Global variable that your program sets whenever it is about to call a GPIB function. After it returns from the GPIB library it clears the variable. Code that uses the GPIB library must check the variable before calling the library and only call it if it is clear.

Refer to the VBxxDEMO program for an example. Look at the use of the `GPIBCallInProgress` variable in the program.

When programming with BASIC, there are two versions of all Original Library routines — a subroutine and a function. The subroutines all begin with the letters "`ib`" (for example, `ibclr`) and the functions begin with the letters "`il`" for example, `ilclr`). The only difference between them is how they are called from a BASIC program.

```
Status% = ilclr (0)   or
CALL ibclr 0
```

**Compatability with National Instruments Library**

The library is fully compatible with National Instruments Library source-code. To use existing National Instruments programs with the library, swap the header files.

All VB programs that run with the National Instruments Library include two header files – `NIGLOBAL.BAS` and `VBIB-32.BAS`. Delete these files from the project, and add the appropriate header file (`GPIB-16.BAS`, `GPIB-32.BAS` or `GPIB-32M.BAS`).

## Developing Programs for Visual C++ for Windows

The Visual C++ interface combines support for both the 16- and 32-bit versions of Visual C++.

| GPIB Library Component | Used with 16-bit? | Used with 32-bit? |
|---|---|---|
| `GPIB.DLL` — the GPIB library | Yes | No |
| `GPIB.LIB` — the GPIB library's 16-bit import library | Yes | No |
| `GPIB-32.DLL` — 32-bit "thunk" layer DLL | No | See note |
| `GPIB-16.DLL` — 16-bit "thunk" layer DLL | No | See note |
| `GPIB-32.DLL` — 32-bit GPIB library | No | See note |
| `GPIB-32.LIB` — The GPIB library's 32-bit import library | No | Yes |
| `WINDECL.H` — The Visual C++ header file | Yes | Yes |
| `GPIBVXD.386` — Device driver, loaded by \windows\system.ini file | Yes | Yes |

| GPIB Library Component | Used with 16-bit? | Used with 32-bit? |
|---|---|---|
| NTGPIBDD.SYS — Device driver for Windows NT/2000/XP | No | Yes |
| **Note**: If you are using the 32-bit GPIB library, the only DLL is GPIB-32.DLL. If you are using the 16-bit library with a 32-bit VC++ program, you can employ the 16-bit GPIB library together with the "thunk" layer DLLs GPIB-16.DLL and GPIB-32.DLL | | |

**Sample Programs** The example program is installed by default in the C:\GPIB_32\C\ (32-bit) and C:\CBI_GPIB (16-bit) directories. Refer to the example program in the approriate directory.

**Versions Supported** Visual C++ for Windows — all versions

**Header File** All C or C++ programs that use the GPIB library must include the WINDECL.H file. Add the following line to the start of your program.

```
#include "windecl.h"
```

**Adding the library to your project**

Each program that uses the GPIB library must be linked to the appropriate Import Library file. There are two import libraries provided:

GPIB.LIB for the 16-bit Visual C++
GPIB-32.LIB for the 32-bit Visual C++

The details are not the same for different versions of Visual C++. It is beyond the scope of this document to try and cover all the different versions.

**Note for Borland**: To use the GPIB library with Borland C++, use the Borland IMPLIB tool to create a Borland-compatible import library. Also, depending on the particular Borland package (and version), you may need to make some small adjustments to the WINDECL.H include file.

**Compatibility with National Instruments Library**

The library is fully compatible with the National Instruments Library source code. To use existing National Instruments programs with the library, swap the header files and libraries.

All VC++ programs that run with the National Instruments Library include a header file - DECL-16.H or DECL-32.H. The "#include DECL-xx.H" in the C source code should be replaced with an include of the header file as described above.

All VC++ programs that run with the National Instruments NI-488.2M Library also include an OBJ file (GPIB-32.OBJ) in their project. Follow the instructions above for adding the library but before adding it, delete the National Instruments OBJ file from the project.

## Developing Programs in QuickBASIC/BASIC (DOS)

These files form the QuickBASIC/BASIC Interface:

| | |
|---|---|
| GPIBQB.QLB | A library of GPIB routines to be used with QuickBASIC |
| GPIBQB.LIB | A library file linked to compiled programs to create stand-alone executable files. |
| DECL.BAS | BASIC header file |

**Versions Supported** QuickBASIC 4.0 and Higher

**Preparing the Environment**

Before you begin to write your programs, copy the following files from the GPIB install directory to your working directory.

`GPIBQB.QLB`

`GPIBQB.LIB`

`GPIB.CFG`

`DECL.BAS`

**Header File**

Be sure to include the following line within your program:

```
'$INCLUDE: 'decl.bas'
```

Including this file allows QuickBASIC/BASIC to check that the correct number and type of parameters are specified for each routine called.

**Using the GPIB library from within QuickBASIC**

To Load the GPIB library, be sure that the file `GPIBQB.QLB` is located where QuickBASIC can find it. Then, invoke QuickBASIC by typing:

```
qb /Lgpibqb yourprog
```

where:

`yourprog` is the name of your program.

After you have entered the QuickBASIC environment, compile the program as you normally would.

**Compiling with the Command Line Compiler**

This process compiles the BASIC source code and links it to the BASIC and GPIB library files. Compile the code by typing:

```
bc /o /d yourprog.bas
link yourprog,,,bcom45+gpibqb;
```

where:

yourprog is the name of your program.

bcom45 is the QuickBASIC Runtime library name.

gpbiqb is the linkable BASIC library file.

Also refer to the `MAKEQB.BAT` file in the `\DOS_BAS` subdirectory of your install directory.

**Special Programming Notes**

Parameters can be passed as either variables or constants. For example:

```
DevName$ = "VoltMeter"

CALL ibfind (DevName$, Dev%)
```

is the same as:

```
CALL ibfind ("VoltMeter", Dev%)
```

When programming with Quick BASIC, there are two versions of all Original Library routines - A subroutine and a function. The subroutines all begin with the letters "`ib`" (for example, `ibclr`) and the functions begin with the letters "`il`" (for example, `ilclr`). The only difference between them is how they are called from a BASIC program.

```
Status% = ilclr (0)
```

or

```
CALL ibclr 0
```

`SAMPLE.BAS` illustrates the use of several of the GPIB library routines.

## Developing GPIB Programs with HP VEE

HP VEE is a graphic programming environment from Hewlett Packard that works with the GPIB library. HP Vee comes with hundreds of Instrument drivers that simplify the programming of most common GPIB instruments.

**Enabling GPIB Support Within HP VEE**

HP VEE automatically recognizes that the GPIB library has been installed on your system. However, if you also have a National Instruments GPIB library on your system, HP VEE may recognize the wrong library. In that case, you should rename or remove the following National Instruments files from your system.

```
\windows\system\gpib.dll
```

```
\windows\system\gpib-16.dll
```

```
\windows\system\gpib-32.dll
```

**Earlier than HP Ver 4.0**

If you are using a HP VEE version less than 4.0, GPIB support is automatically enabled. The GPIB board is installed as GPIB interface 14. All GPIB devices within HP VEE have a 4 digit address property - 14xx, where xx is the GPIB address of the device. For example if you have a signal generator set to GPIB address 7, then the address field for this device is set to 1407. This address (1407) should be used throughout VEE whenever you want to access that device.

**Ver 4.00**

If you are using version 4.0 (or greater) of HP VEE, first copy the GPIB DLL files from the `C\gpib_32` directory into the `\windows\system` directory.

Run HP Vee. Select **I/O** from VEE's main menu bar, then select **Instrument Manager** to display the Instrument Manager dialog box. Press the **refresh** button on the right. The panel on the left updates with a new driver called `HP-IB0`. This is the GPIB library.

Select `HP-IB0` on the left panel, then press the `Edit..` button. A small `Interface Configuration` dialog box appears. Change the address field to `14`, then select `OK` to close the dialog.

The `HP-IB0` in the left pane has changed to `HP-IB14`. Select `HP-IB14` and press the refresh button again. All devices that connected to the GPIB boards appear beneath the `HP-IB14` icon in the left pane. Each device icon has a "`?`" superimposed on it to indicate that the system does not yet know what type of device it is.

Select one of the unknown devices and press "refresh" again. A small dialog box appears that says "`OK to Send '*IDN?`' to NewDevice. If you select `OK`, the system sends this command to the instrument. "`*IDN?`" is a standard (SCPI) command which instructs the device to send back an identification string. Many GPIB instruments respond to this command, and the system automatically recognizes which type of device it is.

Select one of the devices and press the **Edit** button. The address field should be set to a 4 digit number - `14xx`, where `xx` is the GPIB address of the device. For example if you have a signal generator set to GPIB address `7`, then the address field for this device is set to `1407`. This address (`1407`) should be used throughout VEE to access that device.

## Developing Programs in Professional Basic (DOS)

These files form the Professional BASIC Interface:

| | |
|---|---|
| `GPIBPB.QLB` | A library GPIB routine to use within a Professional BASIC development environment. |
| `GPIBPB.LIB` | A library file which is linked to compiled programs to create stand-alone executable files. |
| `DECL.BAS` | BASIC header file |
| **Versions Supported** | Professional BASIC 4.0 and higher |

**Preparing the Environment**

Before you begin to write your programs, copy the following files from the GPIB install directory to your working directory:

`GPIBQB.QLB`

`GPIBQB.LIB`

`GPIB.CFG`

`DECL.BAS`

**Header File**

Be sure to include the following line within your program:

```
'$INCLUDE:'decl.bas'
```

Including this file allows Professional BASIC to check that the correct number and type of parameters are specified for each routine called.

**Compliling Your Program**

This process compiles the BASIC source code and links it to the BASIC and GPIB library files. Compile the code by typing:

```
bc /Fs yourprog.bas
link yourprog,,,gpibpb;
```

where:

`yourprog` is the name of your program.

`gpbiqb` is the linkable BASIC library file.

Refer also to the `MAKEQB.BAT` file in the \DOS_BAS subdirectory of your install directory.

**Special Programming Notes**

Parameters can be passed as either variables or constants. For example:

```
DevName$ = "VoltMeter"
        CALL IBFIND (DevName$, Dev%)
```

is the same as:

```
        CALL IBFIND ("VoltMeter", Dev%)
```

When programming with BASIC, there are two versions of all Original Library routines - A subroutine and a function. The subroutines all begin with the letters "ib" (for example, ibclr) and the functions begin with the letters "il" (for example, ilclr). The only difference between them is how they are called from a BASIC program.

```
Status% = ilclr (0)    or
CALL ibclr 0
```

**Sample Program** SAMPLE.BAS illustrates the use of several of the GPIB library routines.

## Developing Programs in Microsoft C/Turbo C/
Borland C/C++ (DOS)

There are several files which comprise this interface:

| | |
|---|---|
| GPIBCL.LIB | Library File for Microsoft C Large Model. |
| GPIBCM.LIB | Library File for Microsoft C Medium Model. |
| GPIBCS.LIB | Library File for Microsoft C Small Model. |
| DECL.H | C Header file. |

**Versions Supported** Microsoft C version 3.0 and later

**Preparing the Environment**

Before you begin to write your programs, copy the following files to your working directory:

GPIBCS.LIB (depending on memory model)

GPIBCM.LIB

GPIBCL.LIB

DECL.H

GPIB.CFG

**Header File** When you write your program, make sure to include the line:

```
#include <decl.h>
```

The DECL.H file is a header file which defines the GPIB library routines. In particular, it defines the type and number of parameters associated with each routine.

**Compiling Your Program**

When the source code is compiled, it is linked to the appropriate GPIB.LIB file. This process forms a stand-alone executable (.exe) file.

Compile your program in the normal manner and link it with the correct library.

For example, at the DOS prompt, you might type either:

```
cl yourprog.c /link gpibcs.lib
```

or

```
cl /c yourprog.c;
link yourprog,,,gpibcs/lib;
```

This assumes you are using the small memory model. Also refer to the MAKEMC.BAT (Microsoft C) and MAKETC.BAT (Turbo C) files.

### Special Programming Notes

Parameters which are not pointers to int's or unsigned's may be passed as constants rather than variables.

It is very important that the number of bytes allocated for storage within a character array is at least one greater than the maximum byte count passed into the routine. This extra byte is necessary so to accommodate the NULL which marks the end of the received data. If a routine attempts to receive more bytes than have been allocated for storage into that variable, your program may crash.

Note that the routine descriptions in Chapter 4 GPIB 488.1 Library Reference use "`int`" in the syntax of most of the 488.1 library routine arguments. However, the `DECL.H` header file shows the routine declarations as using "`:short`". This is not a contradiction for the 16-bit world since "`short`" and "`int`" are the same.

# GPIB 488.1 Library Reference

This chapter describes each of the 488.1 GPIB library routines. A short description of the routine, its syntax, parameters, any values that are returned, any special usage notes, and an example are included for each routine. The routines are listed in alphabetical order. The following table lists all of the 488.1 GPIB library routines. A full description of each routine follows the table.

Table 4-1. 488.1 Library routines

| Name | Description |
|---|---|
| ibask | Returns software configuration information |
| ibbna | Change access board of device |
| ibcac | Become Active Controller |
| ibclr | Clear specified device |
| ibcmd | Send GPIB commands from a string |
| ibcmda | Send GPIB commands asynchronously from a string |
| ibconfig | Configure the driver |
| ibdev | Open and initialize a device when the device name is unknown |
| ibdma | Enable/Disable DMA |
| ibeos | Change EOS |
| ibeot | Change EOI |
| ibevent | Returns oldest recorded event |
| ibfind | Open a device and return its unit descriptor |
| ibgts | Go from Active Controller to standby |
| ibinit | Reinitializes library, reloads software configuration |
| ibist | Define IST bit |
| iblines | Return status of GPIB bus lines |
| ibln | Check fpr presence of device on bus |
| ibloc | Got to Local |
| ibonl | Place device online/offline |
| ibpad | Change Primary address |
| ibpct | Pass Control |
| ibppc | Parallel Poll Configure |
| ibrd | Read data to a string |
| ibrda | Read data asynchronously |
| ibrdf | Read data to file |
| ibrdi | Read data to integer array |
| ibrdia | Read data asynchronously to integer array |
| ibrpp | Conduct parallel poll |
| ibrsc | Request/release system control |
| ibrsp | Return serial poll byte |
| ibrsv | Request service |
| ibsad | Define secondary address |
| ibsic | Send IFC |
| ibsre | Set/clear REN line |
| irsrq | Install an SRQ interrupt routine |
| ibstop | Stop asynchronous I/O operation |
| ibtmo | Define time limit |
| ibtrg | Trigger selected device |

| Name | Description |
|---|---|
| ibwait | Wait for event |
| ibwrt | Write data from a string |
| ibwrta | Write data asynchronously from a string |
| ibwrtf | Write data from file |
| ibwrti | Write data from integer array |
| ibwrtia | Write data asynchronously |

## IBASK

Returns software configuration information.

### Syntax

```
BASIC     CALL ibask (boarddev%, option%, value%)
C         ibask (int boarddev, int option, unsigned int *value)
PASCAL    ibask (boarddev:integer; option:integer;  var value: integer)
```

### Parameters

`boarddev` A board handle or device handle

`option` Specifies which configuration item to return; see Table 4-2.

`value` Current value of specified item returned here

Table 4-2. `ibask` options

| Option | Valid for | Information returned |
|---|---|---|
| IbaPAD | bd/dev | Primary address of board or device |
| IbaSAD | bd/dev | Secondary address of board or dev |
| IbaTMO | bd/dev | The current timeout value for I/O commands (refer to `ibtmo` for a list of possible values) |
| IbaEOT | bd/dev | 0 = EOI asserted at end of write<br>non zero = EOI is not asserted at end of write |
| IbaPPC | bd | The current parallel poll configuration of the board |
| IbaREADDR | dev | 0 = Forced re-addressing is disabled<br>non zero = Forced re-addressing is enabled. Refer to Force re-addressing on page 9. |
| IbaAUTOPOLL | bd | 0 = automatic at end of write<br>non zero = automatic serial poll is disabled |
| IbaCICPROT | bd | 0 = CIC protocol is disabled<br>non zero = CIC protocol is enabled |
| IbaIRQ | bd | IRQ used for interrupts or 0 if disabled |
| IbaSC | bd | 0 = board is not system controller<br>non zero = board is system controller |
| IbaSRE | bd | 0 = do not automatically assert REN line when system controller<br>non zero = automatically assert REN line when system controller |
| IbaEOSrd | bd/dev | 0 = ignore EOS char during reads<br>non zero = terminate read when EOS char is received |
| IbaEOSwrt | bd/dev | 0 = don't assert EOI line when EOS char is sent<br>non zero = assert EOI line whenever EOS char is sent |
| IbaEOScmp | bd/dev | 0 = 7 bit compare is used when checking for EOS char<br>non zero = 8 bit compare is used when checking for EOS char |
| IbaEOSchar | bd/dev | 0 = The current EOS char of board or device |
| IbaPP2 | bd | 0 = board is in remote parallel poll configuration<br>non zero = board is in local parallel poll configuration |
| IbaTiming | bd | Current T1 timing delay 1 = Normal (2 us), 2 = High Speed (500 ns), 3 = Very High Speed (350 ns) |
| IbaDMA | bd | Low byte = DMA channel, hex 8000 bit indicates DMA enabled<br>Examples: 0x003 = DMA disabled, set for DMA chan 3<br>0x8001 = DMA enabled, set for DMA chan 1 |
| IbaSendLLO | bd | 0 = LLO command is not sent when device is put online<br>non zero = LLO command is sent |

| Option | Valid for | Information returned |
|---|---|---|
| IbaSPollTime | dev | Length of time to wait for parallel poll response before timing out |
| IbaPPollTime | bd | Length of time to wait for parallel port response |
| IbaEndBitIsNormal | bd | 0 = The END bit of ibsta is not set when the EOS character is received without EOI.<br>non zero = The END bit of ibsta is set when the EOS character is received |
| IbaUnAddr | dev | 0 = The untalk and unlisten (UNT, UNL) are not sent after each device level read/write<br>non zero = The UNT, UNL commands are sent after each device lever read/write |
| IbaIST | dev | |
| IbaBNA | dev | Device's access board |
| IbaBaseAddr | bd | Base I/O address of GPIB board |
| IbaBoardType | bd | Type of GPIB board installed:<br>1 = PC2A board with NEC 7210 chip<br>2 = PC2A board with CBI 488.2 chip<br>3 = ISA-GPIB/LC Board<br>4 = ISA-GPIB Board<br>5 = PCM-GPIB Board<br>6 = PCI-GPIB Board<br>7 = PC104-GPIB Board |
| IbaChipType | bd | Type of GPIB controller chip on board:<br>0 = NEC 7210<br>1 = MCC CB7210.2 |
| IbaSlotNum | bd | Slot number that board is installed in |
| IbaPCIIndex | bd | PCI bus index for board |
| IbaBaseAdr2 | bd | Address of data register (PCI-GPIB only) |
| IbaUseFIFOs | bd | 0 = Use FIFOs where appropriate<br>1 = Always use FIFOs<br>2 = Never use FIFOs |

**Returns**

ibsta will contain a 16-bit status word; refer to Appendix B.

iberr will contain an error code if an error occurred

value will contain the current value of selected configuration item

**Usage notes**

Some options apply to boards, some to devices and some apply to both boards and devices.

The current value of each configuration item is initially controlled by the CBCONF configuration program. A program may modify many of these configuration items via library routines (for example, ibtmo, ibeos, etc.). In that case, ibask returns the modified version. To restore the original configuration information as specified by your configuration program, call the ibinit routine.

**Example** Returns the primary address of the device named "VoltMeter".

```
BASIC  CALL ibfind ("VoltMeter", dev%)
       CALL   ibask (dev%, IbaPAD, address%)

C      int dev, address;
       dev = ibfind ("Voltmeter");
       ibask (dev, IbaPAD, &address);

PASCAL var
          dev: integer;
          address: integer;
       begin
          dev := ibfind ("Voltmeter");
          ibask (dev, IbaPAD, address);
```

## IBBNA

**Purpose** Allows you to re-assign a device to another GPIB interface board.

**Syntax**

| | |
|---|---|
| BASIC | `CALL ibbna (device%, boardname$)` |
| C | `ibbna (int device, char boardname[])` |
| PASCAL | `ibbna (device:integer; varboardname:string)` |

**Parameters** `device` is an integer containing the device handle

`boardname` is the name of the new board to be assigned the device

**Returns** `ibsta` will contain a 16-bit status word; refer to Appendix B.

`iberr` will contain an error code if an error occurred

**Usage Notes** This routine changes the board assignment made during the configuration process. The assigned board is used for all subsequent operations involving the specified device until:

- `ibbna` is called again
- `ibonl` or `ibinit` is called
- the sytem is restarted

**Example** Use `ibfind` to return the unit descriptor 5 ("`DEV5`"), a DMM, into the variable `dmm`. The DMM is then associated with the GPIB board "`GPIB1`."

```
BASIC  CALL ibfind("DEV5"), dmm%)
       CALL ibbna (dmm%, "GPIB1")

C      int dmm;
       dmm = ibfind ("DEV5");
       ibbna (dmm, "GPIB1");

PASCAL var
           dmm: integer;
       begin
           dmm := ibfind('DEV5');
           ibbna (dmm, 'GPIB1');
```

## IBCAC

Makes the specified board the Active Controller.

**Syntax**

| | |
|---|---|
| BASIC | `CALL ibcac (board%, sync%)` |
| C | `ibcac (int board, int sync)` |
| PASCAL | `ibcac (board:integer; sync:integer)` |

**Parameters** `board` is an integer containing the board handle

`sync` specifies if the GPIB board is to take control synchronously or asynchronously. If `sync` is 0, the GPIB board takes control asynchronously. Otherwise, it takes control synchronously (immediately).

When the board takes control, the GPIB interface board asserts the ATN line. When taking control *synchronously*, the board waits for any data transfer to be completed and then takes control. Note that if synchronous take control is specified while an `ibrd` or `ibwrt` operation is in progress, the synchronous take control may not occur if a timeout or other error occurs during the `ibrd`/`ibwrt`.

In comparison, if the board is to take control *asynchronously*, it takes control immediately, without waiting for any data transfers to be completed.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. In particular, the `ECIC` error occurs if the specified GPIB board cannot become an Active Controller.

**Usage Notes** This routine is only used when doing board level I/O.

**Example** GPIB board 1 takes control asynchronously.

```
BASIC      CALL ibcac (brd1%, 0)

C          ibcac (brd1, 0);

PASCAL     ibcac (brd1, 0);
```

## IBCLR

**Purpose** Clears a specified device.

**Syntax**

BASIC `CALL ibclr (device%)`

C `ibclr (int device)`

PASCAL `ibclr (device: integer)`

**Parameters** `device` is an integer containing the device handle.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this routine is executed, the GPIB Interface Board (which is currently the CIC) sends its talk address over the GPIB. This makes it the active talker. It then unlistens all devices and addresses the specified device as a listener. Finally, the GPIB board clears the device, by sending the `Selected Device Clear` message.

**Example** This example uses `ibfind` to return the unit descriptor for device 5 ("`DEV5`"), a DMM, into the variable `dmm`. The DMM is then cleared.

BASIC
```
CALL ibfind ("DEV5",dmm%)
CALL ibclr(dmm%)
```

C
```
int dmm;
dmm = ibfind("DEV5");
  /*open instrument*/
ibclr (dmm);
  /* clear it */
```

PASCAL
```
var
    dmm:integer;
begin
    dmm := ibfind ('DEV5');
    ibclr (dmm);
```

## IBCMD

**Purpose** Sends GPIB commands.

**Syntax**

BASIC `CALL ibcmd (board%, cmnd$)`

C `ibcmd (int board, char cmnd[], long bytecount)`

PASCAL `ibcmd (board:integer; command:string; bytecount:Longint)`

**Parameters** `board` is an integer containing the board handle.

`cmnd` is the command string to be sent. This string is comprised of GPIB multiline commands. These commands are listed in Appendix A.

`bytecount` is the number of command bytes to be transferred.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.
`iberr` will contain an error code, if an error occurred.
`ibcnt`, `ibcntl` will contain the number of bytes that were read. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

**Usage Notes** This routine passes only GPIB commands. It cannot be used to transmit programming instructions (data) to devices. Use the `ibrd` and `ibwrt` routines for this purpose.

This routine terminates when any one of the following takes place:

- Commands transfer is successfully completed.
- An error occurs
- A timeout occurs
- A Take Control (TCT) command is sent
- The system controller asserts the IFC (Interface Clear) line.

If your application must perform other functions while processing the GPIB command(s), use `ibcmda`.

**Example** This example prepares the board to talk and addresses three devices (at addresses 8, 9, and 10) to listen.

BASIC
```
command$ = "?_@()*" 'UNL UNT MTA0 MLA8 MLA9 MLA10
CALL ibcmd (board%, command$)
```

C
```
char *command;
command = "\0x3f\0x5f\0x40\0x28\0x29\0x2a"
ibcmd (board, command, 6);
```

PASCAL
```
var
    board:integer;
    command: string;
    bytecount: Longint;
begin
    command := '#63#95#64#40#41#42'
    ibcmd (board, command, 6);
```

## IBCMDA

**Purpose** Transfers GPIB commands asynchronously from a string.

**Syntax**

BASIC `CALL ibcmda (board%, cmnd$)`

C `ibcmda (int board, char cmnd[], long bytecount)`

PASCAL `ibcmda (board:integer; command:string; bytecount:Longint)`

**Parameters** `board` is an integer containing the board handle.

`cmnd` is thecommand string to be sent. This string is comprised of GPIB multiline commands.These commands are listed in Appendix A.

`bytecount` is the number of command bytes to be transferred. Note that in C, although this parameter is of type long, integer values and variables can also be passed.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. An ECIC error is generated if the GPIB Interface Board specified is not the Active Controller. If no listening devices are found, the ENOL error is returned.

`ibcnt`, `ibcntl` will contain the number of bytes tht were read. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

**Usage Notes** This routine is seldom used in typical GPIB applications. The only reason to use asynchronous commands is to free up the machine during lengthy operations. GPIB commands are rarely longer then a half dozen bytes; thus, in most cases, you can use `ibcmd` instead of `ibcmda`.

This routine passes only commands. It is not used to transmit programming instructions (data) to devices. Use the `ibrd`/`ibwrt` routines for this purpose.

This routine terminates when any one of the following takes place:

- Commands transfer is successfully completed
- An error occurs
- A timeout occurs
- A Take Control (TCT) command is sent
- The system controller asserts the IFC (Interface Clear) line.

The specified GPIB Interface Board remains the Active Controller of the GPIB bus after this routine has completed, even if it was not the Active Controller before the routine was called.

Remember that once an asynchronous I/O call has begun, any further calls to a library routine (except for `ibwait` and those functions which do not specify a device or GPIB Interface Board) cannot be executed until the I/O has finished and the GPIB driver and the application have been re-synchronized. This is accomplished by calling one of the following:

`ibwait` (include `CMPL` in the mask) The driver and application are synchronized.

`ibstop` The asynchronous I/O is canceled, and the driver and application are synchronized.

`ibonl` The asynchronous I/O is canceled, the interface has been reset, and the driver and application are synchronized.

Re-synchronization is successful if a CMPL is returned to `ibsta`. See Appendix B for further information.

**Example**

This example prepares the board to talk and addresses three devices (at addresses 8, 9, and 10) to listen. `ibcmda` executes in the background and the program continues into the WHILE loop. This loop calls `ibwait` to update `ibsta` and checks `ibsta` to see if `ibcmda` has completed or an error has occurred. The program may do anything within the WHILE loop except make other GPIB I/O calls.

BASIC

```
Command$ = "?_@()*" 'UNL UNT MTA0 MLA8 MLA9 MLA10
CALL ibcmda (board%, command$)
WHILE (ibsta% AND CMPL+EERR) = 0
    ' Check for complete or error
    CALL ibwait (board%, 0)   ' This updates ibsta
WEND
```

C

```
char command[] = "\0x3f\0x5f\0x40\0x28\0x29\0x2a"
ibcmda (board, command, 6);
while ( (ibsta & CMPL+EERR) == 0)
    ibwait (board, 0);
```

PASCAL

```
var
    command:string;
begin
    command := '#63#95#64#40#41#42';
    ibcmda (board, command, 6);
    while ( (ibsta & CMPL+EERR) = 0)
         ibwait (board, 0);
```

# IBCONFIG

**Purpose** Changes configuration parameters.

**Syntax**

BASIC
```
CALL ibconfig (boarddev%, option%, value%)
```

C
```
ibconfig (int boarddev, unsigned int option,
unsigned int value)
```

PASCAL
```
ibconfig (boarddev:integer; option:integer; value:integer)
```

**Parameters**

`boarddev` is an integer containing either a board handle or device handle

`option` is a number which represents the configuration option to be changed. See Table 4-3.

`value` is the new configuration option value. Allowed values differ according to the option being programmed.

Table 4-3. `ibconfig` options

| Option | Valid for | Description |
|---|---|---|
| IbcPAD | bd or dev | New Primary Address. Available primary addresses range from 0 to 30. `value` can be from 0 to 30 decimal. (See `ibpad`.) |
| IbcSAD | bd or dev | New Secondary Address. There are 31 secondary addresses available. `value` can be 0 or from 96 to 126 decimal. (See `ibsad`.) |
| IbcTMO | bd or dev | Timeout Value. The approximate time that I/O functions take before a timeout occurs. `value` is a number from 0 to 15 which corresponds to timeout values ranging from 10 usec to 100 sec. (See `ibtmo`) |
| IbcEOT | bd or dev | Enable/disable END message. If this option is enabled, the EOI line is asserted when the last byte of data is sent. If `value` = 0, then the EOI line is not asserted. If `value` is non zero, the EOI line is asserted. |
| IbcPPC | | Parallel Poll Configure. Redefines the parallel poll configuration bytes. `value` can be 0, or from 96 to 126 decimal. |
| IbcREADDR | dev | Forced re-addressing. If `value` = 0, forced re-addressing is disabled<br>non zero = Forced re-addressing is enabled.<br>Refer to the device option "Force re-addressing" on page 9. |
| IbcAUTOPOLL | bd | Enable/Disable Automatic Serial Polling. If `value` is 0, then Automatic Serial Polling is disabled. Otherwise, it is enabled. |
| IbcCICPROT | | CIC Protocol. If `value` is 0, then CIC Protocol is not used. Otherwise, CIC Protocol is used. |
| IbcIRQ | bd | Enable/Disable Hardware Interrupts. If `value` is 0, then hardware interrupts are disabled, otherwise `value` specifies the IRQ level the board uses to generate interrupts. |
| IbcSC | bd | Request/Release System Control. If `value` is 0, the board is not able to support routines requiring system controller capability.<br>If `value` is non-zero, the board can support routines requiring system controller capability. |
| IbcSRE | bd | Assert/Unassert REN. If `value` is 0, the REN line is unasserted. Otherwise, the REN line is asserted. |
| IbcEOSrd | bd or dev | Recognize EOS. If `value` is non-zero, a read is terminated when the End-Of-String (EOS) character is detected. Otherwise, EOS detection is disabled. |
| IbcEOSwrt | bd or dev | Assert EOI. If `value` is non-zero, then EOI is asserted when the EOS character is sent. Otherwise, EOI is not asserted. |
| IbcEOScmp | bd or dev | 7/8-bit Comparison. If `value` is zero, compare the low-order 7 bits of the EOS character. Otherwise, compare 8-bits. |

| Option | Valid for | Description |
|---|---|---|
| IbcEOSchar | bd or dev | End-Of-String (EOS) Character. value is the new EOS character. value can be any 8-bit value |
| IbcPP2 | | Parallel Poll Remote/Local. If value is zero, then the GPIB Interface Board is remotely configured for a parallel poll by an external Controller. Otherwise, the GPIB interface board accepts parallel poll configuration commands from your application program. |
| IbcTIMING | bd | Handshake Timing. If value is 1, normal timing (> 2 *sec.) is used. If value is 2, high-speed timing (> 500 nsec.) is used. If value is 3, very high-speed timing (> 350 nsec.) is used. |
| IbcDMA | bd | Enable/Disable DMA. If value is zero, DMA transfers are disabled, otherwise value specifies the DMA channel that the board uses. |
| IbcSendLLO | bd | Send Local Lockout. If value is 0, LLO command is not sent when device is put online; non zero = LLO command is sent |
| IbcBaseAddress | bd | Base address that board is configured for |
| IbcBoardType | bd | Type of GPIB Board being used. value =<br>1: PC2A with NEC 7210<br>2: PC2A board with the MCC CB7210.2 chip<br>3: ISA-GPIB/LC<br>4: ISA-GPIB<br>5: PCM-GPIB<br>6: PCI-GPIB<br>7: PC104-GPIB |
| IbcSPollTime | bd or dev | Serial Poll Timeout. value ranges from 0 to 17 specify timeouts of 10 µsecs to 1000 secs. Refer to Table 4-5 "Timeout codes" on page 77. |
| IbcEndBitIsNormal | bd or dev | If set, causes END status to be set on receipt of EOS. |
| IbcPPollTime | bd | Parallel Poll Timeout. values ranges from 0 to 17 specify timeouts of 10 µsecs to 1000 secs. Refer to Table 4-5 "Timeout codes" on page 77. |
| IbcUnAddr | dev | If value is 0, the untalk and unlisten (UNT, UNL) are not sent after each device level read/write; non zero = the UNT, UNL commands are sent after each device lever read/write |

**Returns** ibsta will contain a 16-bit status word as described in Appendix B.

iberr will contain an error code, if an error occurred.

**Usage Notes** None.

**Example** This example illustrates how to change the timeout value for GPIB Interface Board 1 to 300 msec.

BASIC
```
CALL ibfind ("gpib1", device%)
CALL ibconfig (device%, IbcTMO, 10)
```

C
```
int device;
device = ibfind ("gpib1");
ibconfig (device, IbcTMO, 10);
```

PASCAL
```
var
    device:integer;
begin
    device := ibfind ('gpib1');
    ibconfig (device, IbcTMO, 10);
```

## IBDEV

**Purpose**

Obtains a device handle for a device whose name is unknown. It opens and initializes the device with the configuration given.

**Syntax**

BASIC
```
CALL ibdev (boardindex%, pad%, sad%, timeout%, eot%, eos%, device%)
```

C
```
device = ibdev (int boardindex, int pad, int sad,
int timeout, int eot, int eos)
```

PASCAL
```
device:= bdev(boardindex:Integer;pad:Integer;
sad:Integer;timeout:Integer;eot:Integer;eos:Integer)
```

**Parameters**

`boardindex` identifies the GPIB Interface Board the device descriptor is associated with - index in the range 0 to (total number of boards - 1 ).

`pad` is the primary address of the device. Available addresses range from 0 to 30.

`sad` is the secondary address of the device. There are 31 secondary addresses available. `value` can be 0, or from 96 to 126 decimal; see Appendix A. If 0 is selected, the driver will not expect the device to require a secondary address.

`timeout` is the tmeout of the device. This is a value from 0 to 17 which corresponds to timeout value ranging from 10 usec to 1000 sec. See Table 4-5 "Timeout codes" on page 77 for a list of timeouts and corresponding values.

`eot` when writing to a device, `eot` specifies whether or not to assert `EOI` with the last data byte. If `eot` is non-zero, `EOI` is asserted. If `eot` is 0, `EOI` is not asserted.

`eos` specifies the End-Of-String termination mode to be used when communicating with the device. See Table 4-4 "Selecting EOS" on page 45 for a description of special formatting features of this argument.

**Returns**

`device` will contain the assigned descriptor or a negative number. If `device` is a negative number, then an error occurred. Two types of errors can occur:

- An `EDVR` or `ENEB` error is returned if a device is not available or the board index specifies a non-existent board.
- An `EARG` error is returned if illegal values are given for `pad`, `sad`, `timeout`, `eot`, `eos`.

`iberr` will contain an error code, if an error occurred.

**Usage Notes**

This routine returns the device handle of the first available user-configurable device it finds in the device list. (See the `IBCONF` program description for more information.) Be sure to open all of the devices (with `ibfind`) you plan to use before calling `ibdev`. This guarantees that `ibdev` will not open a device that you intend to open with `ibfind`.

It is very important that you disable the device descriptor (use `ibonl`) when you have finished all operations associated with that device. Otherwise, the device handle is not available for further use with `ibdev`.

If you use `ibdev` and `ibfind` in the same program, you should do the `ibfind`s on all pre-defined devices prior to calling `ibdev`.

**Example**

This example opens an available device, associates it with GPIB interface board 1, and assigns it the following device configuration parameters.

- primary address = 3
- secondary address = 19 (115 decimal, 73 hex)
- timeout = 10 sec
- Assert EOI
- EOS Disabled
- The new device handle is returned.

BASIC
```
CALL ibdev(1, 3, &H73, 13, 1, 0, device%)
```

C
```
int device;
device = ibdev(1, 3, 0x73, 13, 1, 0);
```

PASCAL
```
var
    device: integer;
begin
    device := ibdev(1, 3, $73, 13, 1, 0);
```

## IBDMA

**Purpose** Enables/Disables DMA.

**Syntax**

BASIC `CALL ibdma (board%, dma%)`

C `ibdma (int board, int dma)`

PASCAL `ibdma (board:integer; dma:integer)`

**Parameters** `board` is an integer containing the `board` handle.

`dma` is an integer which indicates whether DMA is to be enabled or disabled for the specified GPIB board. If `dma` is non-zero, all read and write operations between the GPIB board and memory are performed using DMA. Otherwise, programmed I/O is used.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. An `ECAP` error results if you tried to enable DMA operations for a board which does not support DMA operation. If no error occured, the previous value of `dma` is stored in `iberr`.

**Usage Notes** The GPIB Interface Board must have been configured for DMA operations in order for this routine to be executed successfully. (Refer to the `IBCONF` program.) This routine is useful for alternating between programmed I/O and DMA operations. This call remains in effect until one of the following occurs:

- Another `ibdma` call is made.
- `ibonl` or `ibfind` is called.
- The program is re-started.
- The maximum DMA transfer length in Windows is 64 K bytes.

**Example** This example enables DMA transfers for GPIB Interface Board 1. It assumes that the DMA channel was previously selected in your configuration program.

```
BASIC   CALL ibfind ("gpib1", board%
        CALL ibdma (board%, 1)

C       int board, ibsta;
        board = ibfind ("gpib1");
        ibsta = ibdma (board, 1);

PASCAL  var
            board:integer;
        begin
            board := ibfind ('gpib1');
            ibsta := ibdma(board, 1);
```

## IBEOS

**Purpose** Changes or disables End-Of-String termination mode.

**Syntax**

BASIC
```
CALL ibeos (boarddev%, eos%)
```

C
```
ibeos (int boarddev, int eos)
```

PASCAL
```
ibeos (boarddev:integer; eos:integer)
```

**Parameters** `boarddev` is an integer containing the board/device handle.

`eos` is an integer that defines which termination mode and what EOS character are to be used, as shown in Table 4-4.

Table 4-4. Selecting EOS

| Method | Description | eos | |
|---|---|---|---|
| | | High Byte | Low Byte |
| A | Terminate *read* when EOS is detected. Can be used alone or in combination with Method C. (Constant = `REOS`) | 0000100 | EOS character |
| B | Set EOI with EOS on *write* function. Can be used alone or in combination with Method C. (Constant = `XEOS`) | 00001000 | EOS character |
| C | Compare all 8 bits of EOS byte rather than low 7 bits for all read and write functions. (Constant = `BIN`) | 00010000 | EOS character |

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. If an error does not occur the previous value of `eos` is stored in `iberr`.

**Usage Notes** This call only defines an EOS byte for a board or device. It does not cause the handler to automatically send that byte when performing writes. Your application must include the EOS byte in the data string it defines.

If this call defines an EOS for a *device*, then the defined EOS is used for all reads and writes involving that device. Likewise, if the call defines an EOS for a *board*, then all reads and writes involving that board will use that EOS.

This call remains in effect until one of the following occurs:

- Another `ibeos` call is made.
- `ibonl` or `ibfind` is called.
- The system is re-started.

See also `ibeot`

To set the EOS byte permanently, use the `CBCONF` utility program. Then, you need only call `ibeos` when you want to change the default EOS byte.

**Example** This example configures the GPIB system to send the END message whenever the line feed character is sent to a particular device. Method B described in Table 4-4 is used (`XEOS`).

BASIC
```
CALL ibeos (device%, XEOS + &H0A )
```

C
```
int device;
ibeos (device, XEOS + '\n');
```

PASCAL
```
var
    device:integer;
begin
    ibeos (device, XEOS + $0A);
```

## IBEOT

**Purpose** Enables/Disables assertion of EOI on write operations.

**Syntax**

BASIC `CALL ibeot (boarddev%, eot%)`

C `ibeot (int boarddev, int eot)`

PASCAL `ibeot (boarddev: integer, eot: integer)`

**Parameters** `boarddev` is an integer containing the unit descriptor. Here it represents a GPIB Interface Board or a device. This value is obtained by calling the `ibfind` routine.

`eot` is an integer which defines whether or not EOI is to be asserted. If `eot` is non-zero then EOI is asserted automatically when the last byte of the message is sent. If `eot` is 0, then EOI is not asserted.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This call is used to temporarily change the default EOT setting.

It is useful to automatically send EOI with the last data byte in situations where variable length data is being sent. When EOI is enabled, you do not need to send an EOS character.

If this call specifies a *device*, then EOI is asserted/unasserted on all *writes* to that device. Likewise, if the call specifies a *board*, then EOI is asserted/unasserted on all writes from that board. To assert EOI with an EOS, use the `ibeos` routine. This call remains in effect until one of the following occurs:

- Another `ibeot`call is made.
- `ibonl` or `ibfind` is called.
- The system is re-started.

See also `ibeos`

**Example** Assert EOI with last byte of all write operations from GPIB board 1.

BASIC
```
CALL ibfind ("gpib1", device%)
CALL ibeot (device%, 1)
```

C
```
int device;
device = ibfind ("gpib1");
ibeot (device,1);
```

PASCAL
```
var
    device:integer;
Begin
    device := ibfind ('gpib1');
    ibeot (device, 1);
```

## IBEVENT

**Purpose** Returns the oldest recorded event

**Syntax**

BASIC `CALL ibevent (board%, event%)`

C `ibevent (short board, unsigned short *event)`

PASCAL `ibevent (board:integer; var:event:integer)`

**Parameters** `Board` is the board handle

`Event` is the event is returned here.

**Returns** `Ibsta` will contain a 16-bit status word described in Appendix B.

`Iberr` will contain an error code if an error occurred.

`Ibcnt` will contain the number of events remaining in queue.

`event` will contain zero.

**Usage Notes** This function is included for compatibility reasons — the GPIB library does not support an event queue. The return value is always zero.

**Example** This example returns the next event in the board's queue

BASIC
```
CALL ibfind ("GPIB0", board%)
IF (ibsta% AND EEVENT) <> 0 THEN
    CALL ibevent (board%, event%)
END IF
```

C
```
int board, event;
board = ibfind ("GPIB0");
if (ibsta & EVENT)
    ibevent(board, &event);
```

PASCAL
```
var
    board: integer;
    event: integer;
begin
    board := ibfind ("GPIB0");
    if (ibsta and EVENT) <> 0 then
         ibevent (board, event);
```

## IBFIND

**Purpose** Opens a board or device and returns the handle associated with a given name.

**Syntax**

BASIC `CALL ibfind (name$, boarddev%)`

C `boarddev = ibfind (char name[])`

PASCAL `boarddev := ibfind (var name:nbuf)`

**Parameters** `name` is the string specifying the board or device name. It must match the configured board or device name specified in your configuration program.

**Returns** `boarddev` will contain the device handle associated with the given `name`. If a negative number is returned, this indicates that the call has failed. This most often happens when the specified `name` is does not match the default/configured board or device name.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This call is also opens the device/board and initializes the software parameters to their default configuration settings. See `ibonl`.

**Example** This example returns the device handle associated with the device named "`DEV5`" to the variable `dmm`. If the device name is not found, the program will jump to an error routine.

```
BASIC    dmm% = ilfind ("DEV5)
         If dmm% < 0 Then PrintError

C        dmm = ibfind("DEV5");
         if (dmm < 0) error()

PASCAL   dmm := ibfind('DEV5');
         if (dmm < 0) error();
```

## IBGTS

**Purpose** Puts an Active Controller in Standby mode.

**Syntax**

BASIC `CALL ibgts (board%, handshake%)`

C `ibgts (int board, int handshake)`

PASCAL `ibgts (board:integer; handshake : integer)`

**Parameters** `board` is an integer containing the board handle.

`handshake` determines whether or not the shadow handshake option is to be activated. If `handshake` is non-zero, then the GPIB shadow handshake option is activated. This means that the GPIB board shadow handshakes the data transfer as an acceptor and when the `END` message is detected, the GPIB board enters a `Not Ready For Data` (`NRFD`) handshake hold-off state on the GPIB. Thus, the GPIB board participates in the data handshake as an Acceptor without actually reading the data. It monitors the transfers for the `END` message and holds off subsequent transfers. Using this mechanism, the GPIB board can take control synchronously on a subsequent operation like `ibcmd` or `ibrpp`.

If `handshake` is 0, then no shadow handshake or holdoff is done.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. The `ECIC` error occurs if the board is not an Active Controller.

**Usage Notes** This call makes the GPIB board go to Controller Standby state and unasserts the ATN line if it is initially the Active Controller. This allows transfers between GPIB devices to occur without the GPIB board's intervention.

Before performing an `ibgts` with a shadow handshake, use the `ibeos` function to define/disable EOS character detection.

**Example** This example uses the `ibcmd` routine to instruct GPIB board 1 to unlisten all devices (ASCII ?, hex 3F), and then to address a Talker at MTA26 (ASCII Z, hex 5) and a Listener at MLA11 (ASCII +, hex 2B). `ibgts` is then called to unassert the ATN line and place the GPIB board in Standby mode. This action allows the Talker to send messages to the Listener. Note that the GPIB commands/addresses are coded using printable ASCII characters, for example, "`?Z+`".

BASIC
```
CALL ibfind ("GPIB1", gpib1%)
CALL ibcmd (gpib1%, "?Z+")
CALL ibgts(gpib1%, 1)
```

C
```
int gpib1;
gpib1 = ibfind ("GPIB1");
ibcmd (gpib1, "?Z+", 3);
ibgts (gpib1, 1);
```

PASCAL
```
var
    gpib1: integer;
begin
    gpib1 := ibfind ('GPIB1');
    ibcmd (gpib1, '?Z+', 3);
    ibgts (gpib1, 1);
```

## IBINIT

**Purpose** Re-initialize board, reload configuration information.

**Syntax**

BASIC `CALL ibinit (board%)`

C `ibinit (short board)`

PASCAL `ibinit (board:integer)`

**Parameters** `Board` is a board handle.

**Returns** `Ibsta` will contain 16-bit status word described in Appendix B.

`Iberr` will contain an error code if an error occurred.

**Usage Notes** This routine is useful if you change the configuration (with `CBCONF`) while a GPIB program is running. If the program calls `ibinit`, the new configuration is loaded.

This routine can also work around a potentially confusing problem when using the library from Windows. The Windows library is a DLL which is shared between all programs that use it. When the DLL is first called, the system loads it into memory, and the DLL loads configuration information. Normally, when the GPIB program terminates the DLL is unloaded. If the program is run again the whole process is repeated. If more than one program is using the DLL, or when running from some programming environments, the DLL may not be unloaded when the program terminates. In that case, a call to `ibinit` at the start of the program will force the configuration info to be reloaded.

**Example** This example reloads the configuration information.

BASIC
```
CALL ibfind ("GPIB0", board%)
CALL ibinit (board%)
```

C
```
int board;
board = ibfind ("GPIB0");
ibinit (board);
```

PASCAL
```
var
    board: integer;
begin
    board := ibfind ('GPIB0');
    ibinit (board);
```

## IBIST

**Purpose** Sets/Clears the `IST` (Individual Status) Bit of the GPIB board for parallel polls.

**Syntax**

`BASIC` `CALL ibist(board%, statusbit%)`

`C` `ibist (int board, int statusbit)`

`PASCAL` `ibist (board:integer; statusbit:integer)`

**Parameters** `board` is an integer containing the board handle.

`statusbit` indicates whether the IST bit is to be cleared or set. If `statusbit` is non-zero, then the IST bit is set. Otherwise, if `statusbit` = 0, the IST bit is cleared.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. If an error does not occur, the previous IST value is stored in `iberr`.

**Usage Notes** This routine is used when the GPIB Interface is not the Active Controller.

IST should be SET to indicate to the controller that service is required.

**Example** This example clears GPIB Board 1's IST bit.

BASIC
```
gpib1% = ilfind ("GPIB1")
ibsta% = ilist (gpib1%, 0)
```

C
```
int gpib1;
gpib1 = ibfind ("GPIB1");
ibist (gpib1, 0);
```

PASCAL
```
var
    gpib: integer;
begin
    gpib1 = ibfind ('GPIB1');
    ibist (gpib1, 0);
```

## IBLINES

**Purpose** Returns the status of the GPIB control lines.

**Syntax**

BASIC `CALL iblines (board%, clines%)`

C `iblines (int board, short *clines)`

PASCAL `iblines (board:integer; clines:integer)`

**Parameters** `board` is an integer containing the board handle.

**Returns** `clines` contain a valid mask and GPIB control line state data. Low-order bytes (bits 0 through 7) contain the mask indicating the capability of the GPIB interface board to sense the status of each GPIB control line. Upper bytes (bits 8 through 15) contain the GPIB control line state information. The pattern of each byte is as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| High | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| | EOI | ATN | SRQ | REN | IFC | NRFD | NDAC | DAV |
| Low (Mask) | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

To determine if a GPIB control line is asserted, first check the appropriate bit in the lower byte to determine if the line can be monitored (indicated by a 1 in the proper bit position), then check the corresponding bit in the upper byte. If the bit is set (1), the corresponding control line is asserted. If the bit is clear (0), the control line is unasserted.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

Handshake Information:

- NRFD = Not Ready for Data
- NDAC = Not Data Accepted
- DAV = Data Valid

Interface Management:

- ATN = Attention
- IFC = Interface Clear
- REN = Remote Enable
- SRQ = Service Request
- EOI = End or Identify

**Usage Notes** In order for this call to function properly, all devices attached to the GPIB bus must adhere to IEEE-488 specification.

Different Measurement Computing GPIB boards have more or less ability to monitor individual GPIB control lines. The mask bits in clines (bits 0-7) indicate which lines the installed board is capable of monitoring.

**Example** This example tests the state of the ATN line.

BASIC

```
CONST ATNline% = &H40
CALL iblines (board%, lines%)
IF lines% AND ATNline% = 0 THEN
    PRINT "ATN line cannot be monitored by this GPIB board"
ELSE IF (lines% / 256) AND ATNline% = 0 THEN
    PRINT "ATN line is not asserted"
ELSE
    PRINT "ATN line is asserted"
END IF
```

C

```
#define ATNLINE = 0x40
int lines;
iblines (board, &lines);
if (lines & ATNLINE == 0)
    printf "ATN line can not be monitored by this GPIB board";
else if ( (lines >> 8) & ATNLINE ) == 0)
    printf "ATN line is not asserted";
else
```

PASCAL

```
const
    ATNLINE := $40
var
    lines:integer;
begin
    iblines(board, lines);
    if lines and ATNLINE = 0 then
        writeln ('ATN line can not be monitored by this GPIB board');
    else if (lines/256) and ATNLINE = 0 then
         writeln ('ATN line not asserted');
    else
         writeln ('ATN line is asserted');
```

## IBLN

**Purpose** Check that a device is present on the bus.

**Syntax**

BASIC `CALL ibln (board%, pad%, sad%, listen%)`

C `ibln (int board, int pad, int sad, short* listen)`

PASCAL `ibln (board:integer, pad:integer,sad:integer, var listen:integer)`

**Parameters** `board` is the board or device handle.

`pad` is the primary address of the GPIB device (0-30)

`sad` is the secondary address of the GPIB device (96-126 or 0x60-0x7e) or one of the constant values NO_SAD or ALL_SAD

`listen` is the variable that the result is returned to.

**Returns** `ibsta` will contain 16-bit status word described in Appendix B.

`iberr` will contain an error code if an error occurred.

`listen` will contain 0 if no listener is found. Contains non-zero if a listener is found.

**Usage Notes** Set `sad` = NO_SAD (0) if the device does not have a secondary address.

Set `sad` = ALL_SAD (-1) if you do not know the device's secondary address and you want all possible secondary addresses to be tested

**Example** This example tests for the presence of a device with a GPIB address of 4.

BASIC
```
CALL ibfind ("GPIB0", board%)
CALL ibln (board%, 4, 0, listen%)
```

C
```
int board, listen;
board = ibfind ("GPIB0");
ibln (board, 4, NO_SAD, &listen);
```

PASCAL
```
var
    board: integer;
    listen: integer
begin
    board := ibfind ('GPIB0');
    ibln (board, 4, NO_SAD, listen);
```

## IBLOC

**Purpose** Forces the specified board/device to go to local program mode.

**Syntax**

BASIC `CALL ibloc (boarddev%)`

C `ibloc (int boarddev)`

PASCAL `ibloc (boarddev:integer)`

**Parameters** `boarddev` is an integer containing the device or board handle.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This routine is used to place boards or devices temporarily in local mode. *If this routine specifies a device*, the following GPIB commands are sent:

- Talk address of the access board
- Secondary address of the access board
- Unlisten (UNL)
- Listen address of the device
- Secondary address of the device (as necessary)
- Go to Local (GTL)

*If this routine specifies a board*, the board is placed in a local state by sending the Return to Local (RTL) message, if it is not locked in remote mode. The LOK bit of the status word indicates whether the board is in a lockout state. The `IBLOC` function is used to simulate a front panel RTL switch if the computer is used as an instrument.

**Example** Return GPIB board 1 to local state.

BASIC
```
CALL ibfind ("GPIB1", gpib1%)
CALL ibloc (gpib1%)
```

C
```
int gpib1;
gpib1 = ibfind("GPIB1");
ibloc (gpib1);
```

PASCAL
```
var
    gpib: integer;
begin
    gpib1 := ibfind('GPIB1');
    ibloc (gpib1);
```

## IBONL

**Purpose** Enables/Disables a device/interface board for operation.

**Syntax**

BASIC `CALL ibonl(boarddev%, online%)`

C `ibonl (int boarddev, int online)`

PASCAL `ibonl (boarddev:integer; online:integer)`

**Parameters** `boarddev` is an integer containing the device/board handle.

`online` defines whether the device/board is to be enabled/disabled. If `online` is non-zero, the device/board is enabled for operation (placed on-line). This restores the board/device to its default settings. Otherwise, the board/device is placed off-line.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When a device is placed off-line, it is in essence "closed". This means that in order to perform any other operations with this device, you will need to re-open it by calling the `ibfind` or `ibdev` routine.

**Example** This example restores the configuration of device 0.

BASIC
```
CALL ibfind ("DEV0", dev0%)
CALL ibonl (dev0%, 1)
```

C
```
int dev0;
dev0 = ibfind ("DEV0");
ibonl (dev0, 1);
```

PASCAL
```
var
    dev0: integer;
begin
    dev0 := ibfind ('DEV0');
    ibonl (dev0, 1);
```

## IBPAD

**Purpose** Changes the primary address assigned to a device or interface board.

**Syntax**

| | |
|---|---|
| BASIC | `CALL ibpad (boarddev%, address%)` |
| C | `ibpad (int boarddev, int address)` |
| PASCAL | `ibpad(boarddev:integer; address:integer)` |

**Parameters** `boarddev` is an integer containing the board or device handle.

`address` specifies the new primary GPIB address. Valid primary addresses range from 0 to 30 (0 to 1E hex).

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code if an error occurred. Contains the previous primary address if no error occurred. `EARG` error occurs if address is out of range.

**Usage Notes** This routine temporarily changes the configuration setting. It remains in effect until `ibonl` or `ibfind` is called, `ibpad` is called again, or the system is re-started.

*If a device is specified*, its talk and listen addresses are assigned on the basis of `address`. Its Listen Address equals `address` + 20 hex. Its Talk Address equals `address` + 40 hex. Thus, if a primary address of 0D hex was specified, the corresponding Listen Address would be 2D hex (MLA 13) and Talk Address would be 4D hex (MTA 13). *If a board is specified*, the board is assigned the primary addressed defined by `address`. Refer also to `ibsad` and `ibonl`.

Be sure that the address specified agrees with the GPIB address of the device. (Set with hardware switches or by a software program. Refer to the device's documentation for more information.)

**Example** This example changes the primary GPIB address associated with DVM ("`DEV4`") to 1C hex.

BASIC
```
CALL ibfind ("DEV4", dvm%)
CALL ibpad (dvm%, &H1C)
```

C
```
int dvm;
dvm = ibfind ("DEV4");
ibpad (dvm, 0x1C);
```

PASCAL
```
var
    dvm: integer;
begin
    dvm := ibfind ('DEV4');
    ibpad (dvm, 0x1C);
```

## IBPCT

**Purpose** Passes control to another device.

**Syntax**

BASIC `CALL ibpct (device%)`

C `ibpct (int device)`

PASCAL `ibpct (device:integer)`

**Parameters** `device` an integer containing the device handle.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This makes the specified device the Controller-In-Charge (CIC). The GPIB board goes to the Controller Idle state and releases the ATN line.

The device that control is passed to must have Controller capability.

**Example** This example makes Device ABCD the Controller-In-Charge.

BASIC
```
CALL ibfind ("ABCD", abcd%)
CALL ibpct(abcd%)
```

C
```
int abcd;
abcd = ibfind ("ABCD");
ibpct(abcd);
```

PASCAL
```
var
    abcd: integer;
begin
    abcd := ibfind ('ABCD');
    ibpct (abcd);
```

## IBPPC

**Purpose** Enables/Disables parallel polling of the specified device.

**Syntax**

BASIC `CALL ibppc (boarddev%, command%)`

C `ibppc (int boarddev, int command)`

PASCAL `ibppc(boarddev:integer; command:integer)`

**Parameters** `boarddev` is the device's handle. This value is obtained by calling the `ibfind` routine.

`command` is a valid parallel poll enable/disable message or 0. If `command` represents a *PPE message*, then the device will use that message to respond to a parallel poll. Valid PPE messages range from 60 to 6F hex. The PPE specifies the GPIB data line ($DIO_1$ through $DIO_8$) on which the device is to respond and whether that line is to be asserted or unasserted.

The PPE byte is of the format:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | SENSE | P2 | P1 | P0 |

Where:

`SENSE` indicates the condition under which the data line is to be asserted. The device compares the value of the sense bit to its IST (individual status) bit and responds appropriately. For example, if SENSE = 1, the device will drive the line TRUE if its IST = 1 or FALSE if IST = 0.

`P2 - P0` specify which GPIB data line should be used to respond to a parallel poll, as shown below:

| P2 | P1 | P0 | GPIB Data Line |
|---|---|---|---|
| 1 | 1 | 1 | DIO8 |
| 1 | 1 | 0 | DIO7 |
| 1 | 0 | 1 | DIO6 |
| 1 | 0 | 0 | DIO5 |
| 0 | 1 | 1 | DIO4 |
| 0 | 1 | 0 | DIO3 |
| 0 | 0 | 1 | DIO2 |
| 0 | 0 | 0 | DIO1 |

For example, if the PPE byte 01101011 (hex 6B) is sent, the device will drive DIO4 true if its IST bit = 1, or false if its IST bit = 0.

If `command` is `0` or represents a *PPD (Parallel Poll Disable) message*, the current PPE (Parallel Poll Enable) configuration is cancelled. Valid PPD messages range from 70 to 7F hex. The PPD is of a similar format to the PPE byte, for example:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | SENSE | P2 | P1 | P0 |

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. Contains the previous value of command if no error occurs.

**Usage Notes** If `boarddev` specifies a *GPIB interface board*, this routine sets the board's Local Poll Enable (LPE) message to `command`.

If `boarddev` specifies a *device*, the GPIB Interface Board associated with the device addresses itself as a Talker, unlistens all devices (sends a UNL), addresses the specifed device as a Listener, and sends the PPC command followed by a PPE or PPD command.

**Example** This example configures device 29 to send DIO7 true if its IST bit = 1.

BASIC
```
dev29% = ilfind ("DEV29")
ibsta% = ilppc (dev29%, &H6B)
```

C
```
int dev29;
dev29 = ibfind ("DEV29");
ibppc (dev29, 0x6B);
```

PASCAL
```
var
    dev29: integer;
begin
    dev29 := ibfind ('DEV29');
ibppc (dev29, $6B);
```

## IBRD

**Purpose** Reads data from a device/interface board into a string.

**Syntax**

BASIC `CALL ibrd (boarddev%, buf$)`

C `ibrd (int boarddev, char buf[], unsigned long bytecount)`

PASCAL `ibrd (boarddev:integer, var buf; bytecount: longint)`

**Parameters** `boarddev` is an integer containing the board or device handle.

`buf` is the storage buffer for the data. Up to 4 gigabytes-1 ($2^{32}$-1 bytes) can be stored. String size may be limited by the language you are using. Check documentation for your language.

`bytecount` specifies the maximum number of bytes to read.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code of the first error detected, if an error occurred. An `EADR` results if the specified GPIB Interface Board is an Active Controller but has not been addressed to listen. An `EABO` error results if a timeout occurs.

`Ibcnt`, `ibcntl` will contain the number of bytes that were read. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

**Usage Notes** A read will terminate when one of the following occurs:

- The allocated buffer becomes full.
- An error is detected.
- The time limit is exceeded.
- A terminator (or EOI) is detected.

If `boarddev` specifies a device, the specified device is addressed to talk and its associated access board is addressed to listen.

If `boarddev` specifies a GPIB Interface board, you must have already addressed a device as a talker and the board as a listener. If the board is the Active Controller, it will unassert ATN in order to receive data. This routine leaves the board in that state.

**Example** This example reads 90 characters of data from `DEV5`.

BASIC
```
dev5% = ilfind ("DEV5")
rd$ = space$(90)
ibsta% = ilrd (DEV5%, rd$)
```

C
```
int dev5;
char rd [90];
dev5 = ibfind ("DEV5");
ibrd (dev5, rd, 90);
```

PASCAL
```
var
    dev5: integer;
begin
    dev5 := ibfind ('DEV5');
    ibrd (dev5, rd, 90);
```

## IBRDA

**Purpose**

Reads data asynchronously from a device/interface board into a string.

**Syntax**

BASIC
```
CALL ibrda (boarddev%, buf$)
```

C
```
ibrda (int boarddev, char buf[], unsigned long bytecount)
```

PASCAL
```
ibrda(boarddev:integer;varbuf;bytecount:longint)
```

**Parameters**

`boarddev` is an integer containing the device/board handle.

`buf` is the storage buffer for the data. Up to 4 gigabytes-1 ($2^{32}$-1 bytes) can be stored. String size may be limited by the language you are using. Check documentation for your language.

`bytecount` specifies the maximum number of bytes to read.

**Returns**

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code of the first error detected, if an error occurred. An `EADR` results if the specified GPIB board is an Active Controller but has not been addressed to listen. An `EABO` error results if a timeout occurs.

`ibcnt`, `ibcntl` will contain the number of bytes that were read. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

**Usage Notes**

A read terminates when one of the following occurs:

- The allocated buffer becomes full.
- An error is detected.
- The time limit is exceeded.
- A terminator (or EOI) is detected.

If `boarddev` specifies a device, the specified device is addressed to talk and its associated access board is addressed to listen.

If `boarddev` specifies a GPIB Interface board, you must have already addressed a device as a talker and the board as a listener. If the board is the Active Controller, it unasserts `ATN` to receive data. This routine leaves the board in that state. Remember that once an asynchronous I/O call has begun, any further calls to a library routine (except for `ibwait` and those functions which do not specify a device or GPIB board) cannot be executed until the I/O has finished and the GPIB driver and the application have been re-synchronized. This is accomplished by calling one of the following:

| | |
|---|---|
| `ibwait` (mask contains CMPL) | The driver and application are synchronized. |
| `ibstop` | The asynchronous I/O is canceled, and the driver and application are synchronized. |
| `Ibonl` | The asynchronous I/O is canceled, the interface has been reset, and the driver and application are synchronized. |

Re-synchronization is successful if a `CMPL` is returned to `ibsta`. See Appendix C for further information.

This command is normally only used for large data transfers. It allows the program run in the foreground while the data transfer continues in the background. Use `ibrd` for small transfers.

**Example**

In this example, ibwrt sends the command "DUMP" to a device. The device responds by sending back a large block of data. ibrda begins a transfer of 5000 bytes in the background and the program continues on into the WHILE loop. The WHILE loop calls ibwait with MASK set to 0 to update IBSTA. The WHILE loop checks IBSTA to see if ibrda has completed, or if an error has occurred. The program may do anything else within the WHILE loop except make other GPIB I/O calls.

BASIC

```
readbuffer = space$(5000)
CALL ibwrt (device%, "DUMP")
CALL ibrda (device%, readbuffer$)
WHILE (ibsta% AND CMPL+EERR) = 0
    ' Check for complete or error
    ibwait (device%, 0)
    ' Other code may be inserted here
WEND
```

**Note for Basic**

You cannot read into a zero length string because the library determines the read length from the string length – pre-allocate the string by filling with characters such as spaces.

C

```
char *readbuffer[5000];
ibwrt (device, "DUMP");
ibrda (device, readbuffer, 5000);
while ( (ibsta & CMPL+EERR) == 0)
    ibwait (device, 0)
```

PASCAL

```
type
    buf = array[1...5000] of char;
var
    readbuffer:buf;
begin
    ibwrt(device, 'DUMP');
    ibrda(device, readbuffer, 5000);
    while ibsta and (CMPL + EERR) = 0
         do IBWAIT (device, 0);
```

## IBRDF

**Purpose** Reads data from the GPIB into a file.

**Syntax**

BASIC `CALL ibrdf(boarddev%, filename$)`

C `ibrdf (int boarddev, char filename [])`

PASCAL `ibrdf (boarddev:integer; var filename:flbuf)`

**Parameters** `boarddev` is an integer containing the device/board handle.

`filename` is the name of the file (up to 250 characters, including drive/path) in which the data is to be stored. Be certain to specify a drive and path if necessary. This file is automatically opened as a binary file. It is created if it does not already exist.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. An `EFSO` error is generated if the file can not be opened, created, found, written to, or closed.

`ibcnt`, `ibcntl` will contain the number of bytes that were read. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`

Usage Notes A read terminates when one of the following occurs:

- The allocated buffer becomes full.
- An error is detected.
- The time limit is exceeded.
- A terminator (or EOI) is detected.
- A DCL or SDC command is received from the Active Controller.

If `boarddev` specifies a device, the specified device is addressed to talk and its associated access board is addressed to listen.

If `boarddev` specifies a GPIB Interface board, you must have already addressed a device as a talker and the board as a listener. If the board is the Active Controller, it unasserts `ATN` in order to receive data. This routine leaves the board in that state.

**Example** This program sends the command "`DUMP`" to a device. The device responds by sending data back. `ibrdf` reads the incoming data and stores it in the file called `gpib.dat` on the C drive.

```
BASIC     CALL ibwrt (boarddev%, "DUMP")
          CALL ibrdf (boarddev%, "c:gpib.dat")


C         ibwrt (boarddev, "DUMP");
          ibrdf (boarddev, "c:gpib.dat");


PASCAL    var
              boarddev: integer;
          begin
              ibwrt (boarddev, 'DUMP')
              ibrdf (boarddev, 'c:gpib.dat');
```

## IBRDI (QuickBASIC, BASIC only)

**Purpose** Reads data into an integer array.

**Syntax**

BASIC `CALL ibrdi(boarddev%, iarr%(), bytecount&)`

C Not Supported

PASCAL Not Supported

**Parameters** `boarddev` is an integer containing the device/board handle.

`iarr` is the integer array into which data is to be read.

`bytecount` specifies the maximum number of bytes to be read.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code of the first error detected, if an error occurred. An `EADR` results if the specified GPIB Interface Board is and Active Controller but has not been addressed to listen. An `EABO` errror results if a timeout occurs.

`ibcnt, ibcntl` will contain the number of bytes that were read. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use ibcntl instead of `ibcnt`

**Usage Notes** As data is read, each byte pair is treated as an integer. In C and PASCAL, `ibrd` can be used to read both strings and integers.

**Example** This example reads 90 bytes of data from a device address at MTA 15 (hex 4F, ASCII 0) to GPIB Board 1. The GPIB board's listen address is MLA 1. (hex 21, ASCII !).

BASIC
```
DIM iarr%(45)          'dimension array as 1/2 of byte count
brd1% = ilfind("GPIB1")
ibsta% = ilcmd (brd1%, "?0!", 3)
ibsta% = ilrdi (brd1%, iarr%(), 90)
```

C
```
Not supported
```

PASCAL
```
Not supported
```

## IBRDIA (QuickBASIC, BASIC only)

**Purpose** Reads data asynchronously data into an integer array.

**Syntax**

BASIC `CALL ibrdia(boarddev%, iarr%(), bytecount&)`

C Not supported

PASCAL Not supported

**Parameters** `boarddev` is an integer containing the device/board handle.

`iarr` is the integer array into which data is to be read.

`bytecount` specifies the maximum number of bytes to be read.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code of the first error detected, if an error occurred. An `EADR` results if the specified GPIB Interface Board is the Active Controller but has not been addressed to listen. An `EABO` errror results if a timeout occurs.

`ibcnt`, `ibcntl` contain the number of bytes that were read. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`

**Usage Notes** As data is read, each byte pair is treated as an integer. The array size (dimension) should be half of the byte count.

Once an asynchronous I/O call has begun, any further calls to a CIO-488 routine (except for `ibwait` and those functions which do not specify a device or GPIB Interface Board) cannot be executed until the I/O has finished and the GPIB driver and the application are re-synchronized. To do this, call one of the following:

`ibwait` (mask contains CMPL). The driver and application are synchronized.

`ibstop` The asynchronous I/O is canceled, and the driver and application are synchronized.

`ibonl` The asynchronous I/O is canceled, the interface is reset, and the driver and application are synchronized.

Re-synchronization is successful if a CMPL is returned to `ibsta`. See Appendix C for further information.

**Example** This example reads 90 bytes of data from a device address at MTA 15 (hex 4F, ASCII 0) to GPIB Board 1. The GPIB board's listen address is MLA 1. (hex 21, ASCII !).

BASIC
```
DIM iarr%(45)          'dimension array as 1/2 of byte count
brd1% = ilfind("GPIB1")
ibsta% = ilcmd (brd1%, "?0!", 3)
ibsta% = ilrdi (brd1%, iarr%(), 90)
```

C
```
Not Supported.
```

PASCAL
```
Not Supported.
```

## IBRPP

**Purpose** Initiates a parallel poll.

**Syntax**

BASIC `CALL ibrpp(boarddev%, command%)`

C `ibrpp (int boarddev, char *command)`

PASCAL `ibrpp (boarddev:integer, var command:byte)`

**Parameters** `device` an integer containing device or board handle.

**Returns** `command` will contain the response to the parallel poll.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** If this routine is called specifying a *GPIB Interface Board*, the board parallel polls all previously configured devices. If the routine is called specifying a *device*, the GPIB Interface board associated with the device conducts the parallel poll. Note that if the GPIB Interface Board to conduct the parallel poll is not the Controller-In-Charge, an ECIC error is generated.

Before executing a parallel poll, the `ibppc` function should configure the connected devices with `ibppc` to specify how they should respond to the poll.

**Example** This program configures two devices for a parallel poll. It then conducts the poll. It is assumed that voltmeter and scope have already been set by opening the devices with an `ibfind` and board has been set by opening the board with an `ibfind`.

Both devices indicate that they want service by setting their first bit to 1. The first `ibppc` specifies that the first device (voltmeter%) should drive the DIO1 line high when its first line goes high. The second `ibppc` specifies that the second device (`scope%`) should drive the DIO2 line high when its first bit goes high. The `ibrpp` conducts the poll and checks DIO1 and DIO2 to see if either device is requesting service.

```
BASIC  CALL ibppc (voltmeter%, &H68)
       CALL ibppc (scope%, &H69)
       CALL ibrpp (board%, pollbyte%)
       IF pollbyte% AND 1 <> 0 THEN
            PRINT "Volt meter is requesting service"
       IF pollbyte% AND 2 <> 0 THEN
            PRINT "Oscilloscope is requesting service"

C      int voltmeter, scope, board, pollbyte;
       ibppc (voltmeter, 0x68)
       ibppc (scope, 0x69)
       ibrpp (board, &pollbyte)
       if (pollbyte & 1)
            printf "Volt meter is requesting service"
       if (pollbyte & 2)
            printf "Oscilloscope is requesting service"
```

```
PASCAL var
          voltmeter, scope, board: integer;
              pollbyte: Byte;
          begin
              ibppc (voltmeter, $68);
              ibppc (scope, $69);
              ibrpp (board, board, pollbyte);
              if pollbyte and 1 then
                   writeln ('Voltmeter is requesting service');
              if pollbyte and 2 then
                   writeln ('Oscilloscope is requesting service');
```

## IBRSC

**Purpose** Request/Release System Control.

**Syntax**

BASIC `CALL ibrsc (board%, control%)`

C `ibrsc (int board, int control)`

PASCAL `ibrsc (board:integer; control:integer)`

**Parameters** `board` is an integer containing the board handle.

`control` indicates whether the GPIB Interface Board is to become the system controller or to relinquish system control capability. If `control` is non-zero, the specified board becomes the system controller on the GPIB. If `control` is 0, the board is not the system controller.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. If no error occurs, `iberr` equals 1 if the specified interface board was previously the system controller or 0 if it was not.

**Usage Notes** There may only be one system controller in a GPIB system.

**Example** This example makes GPIB board 1 the system controller.

BASIC
```
CALL ibfind ("GPIB1", gpib1%)
CALL ibrsc (gpib1%, 3)
```

C
```
int gpib1;
gpib1 = ibfind ("gpib1");
ibrsc (gpib1, 3);
```

PASCAL
```
var
    gpib1: integer;
begin
    gpib1 := ibfind ('gpib1');
    ibrsc (gpib1, 3);
```

## IBRSP

**Purpose** Serial polls a device.

**Syntax**

BASIC `CALL ibrsp(device%, serialpollbyte%)`

C `ibrsp (int device, char *serialpollbyte)`

PASCAL `ibrsp (device:integer; var:serialpollbyte:byte)`

**Parameters** `device` is an integer containing the device handle.

**Returns** `serialpollbyte` will contain the serial poll response byte of the device. The serial poll response byte is device-specific *with the exception of bit 6*. If bit 6 (hex 40) is set, then the device is requesting service. Consult the device's documentation for more information.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** If the automatic serial polling feature is enabled, the specified device may have been automatically polled previously. If it has been polled and a positive response was obtained, the RQS bit of `ibsta` is set on that device. In this case `ibrsp` returns the previously acquired status byte. If the RQS bit of `ibsta` is not set during an automatic poll, it serial polls the device. This routine is used to serial poll one device, and obtain its status byte or to obtain a previously stored status byte. If bit 6 (the hex 40 bit) of the response is set, the device is requesting service.

When a serial poll occurs, the following sequence of events happens. The board sends an UNL (unlisten) command. It then addresses itself as a listener and sends a SPE (Serial Poll Enable) Byte. It then addresses a device as a talker. The board then reads the serial poll response byte from the device. The board then sends a serial poll disable (SPD) and untalks and unlistens all devices.

**Example** Returns the serial response byte (into `serialpollbyte`) of device 1.

BASIC
```
CALL ibfind ("DEVICE1", dev1%)
CALL ibrsp (dev1%, serialpollbyte%)
```

C
```
int dev1;
char serialpollbyte;
dev1 = ibfind ("device1");
ibrsp (dev1, &serialpollbyte);
```

PASCAL
```
var
    dev1: integer;
    serialpollbyte: Byte;
begin
    dev1 := ibfind ('device1');
    ibrsp (dev1, serialpollbyte);
```

## IBRSV

**Purpose** Changes the serial poll response byte of the GPIB board or device.

**Syntax**

BASIC `CALL ibrsv (boarddev%, statusbyte%)`

C `ibrsv (int boarddev, int statusbyte)`

PASCAL `ibrsv (boarddev:integer; statusbyte:integer)`

**Parameters** `boarddev` is an integer containing the board handle.

`statusbyte` represents the serial poll response byte of the GPIB Interface Board. The serial poll response byte is system-specific, *with the exception of bit 6 (hex 40*). If bit 6 (hex 40) is set, then the SRQ line is asserted to indicate to the Controller-In-Charge that the board is requesting service.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. If no error occurs, `iberr` will contain the previous value of `statusbyte`.

**Usage Notes** This routine is used when the specified GPIB Interface Board is not the Controller-In-Charge. It can be used to request service (set bit 6 of the serial response byte) from the Controller-In-Charge or to change the value of GPIB Interface Board's serial poll response byte.

**Example** This example sets the GPIB Interface Board 1 serial poll status byte to 41 hex (assert SRQ) which indicates that the board requires service.

BASIC
```
CALL ibfind ("GPIB1", gpib1%)
CALL ibrsv (gpib1%, &H41)
```

C
```
int gpib1;
gpib1 = ibfind ("gpib1");
ibrsv (gpib1, 0x41);
```

PASCAL
```
var
    gpib1: integer;
begin
    gpib1 = ibfind ('gpbi1');
    ibrsv (gpib1, $41);
```

## IBSAD

**Purpose** Assigns/unassigns a secondary address to a board or device.

**Syntax**

BASIC `CALL ibsad (boarddev%, address%)`

C `ibsad (int boarddev, int address)`

PASCAL `ibsad(boarddev:integer; address:integer)`

**Parameters** `boarddev` is an integer containing device or board handle.

`address` represents the secondary address. If `address = 0` or `address = 7F` hex, secondary addressing is disabled. If `address` is a legal secondary address (60 to 7E hex), the new secondary address is temporarily assigned to the board/device. The new secondary address is used until it is either redefined by calling `ibsad` again, the device/board is re-initialized by callling `ibfind` or `ibonl`, or the program is restarted.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurs. Contains the previously assigned secondary address if no error occurs.

**Usage Notes** See also `ibpad`.

**Example** This example assigns the secondary address 7 (MSA7, hex 67) to device 5.

BASIC
```
CALL ibfind ("DEVICE5", dev5%)
CALL ibsad (dev5%, &H67)
```

C
```
int dev5;
dev5 = ibfind ("DEVICE5");
ibsad (dev5, 0x67);
```

PASCAL
```
var
    dev5: integer;
begin
    dev5 := ibfind ('DEVICE5');
    ibsad (dev5, $67);
```

## IBSIC

**Purpose** Asserts IFC (Interface Clear) signal. This re-initializes the GPIB system.

**Syntax**

BASIC `CALL ibsic (board%)`

C `ibsic (int board)`

PASCAL `ibsic (board:integer)`

**Parameters** `board` is an integer containing the board handle.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. The `ESAC` error is generated if the specified GPIB Interface Board is not the system controller.

**Usage Notes** *This routine can only be used if the specified GPIB board is the system controller.* When the routine is executed, the GPIB interface board asserts the `IFC` (Interface Clear) signal for at least 100 µsec. This action results in the system controller regaining control of the GPIB (for example, becoming the Controller-In-Charge). When `IFC` line is asserted, all GPIB interface functions of the bus devices are reset.

**Example** This example resets the GPIB bus associated with the specified GPIB Interface Board and makes that board Controller-In-Charge.

BASIC
```
CALL ibfind ("GPIB1", gpib1%)
CALL ibsic (gpib1%)
```

C
```
int gpib1;
gpib1 = ibfind("GPIB1");
ibsic (gpib1);
```

PASCAL
```
var
    gpib1: integer;
begin
    gpib1 := ibfind ('GPIB1');
    ibsic (gpib1);
```

## IBSRE

**Purpose** Asserts/Unasserts the REN (Remote Enable) line.

**Syntax**

BASIC `CALL ibsre (board%, ren%)`

C `ibsre (int board, int ren)`

PASCAL `ibsre (board:integer; ren:integer)`

**Parameters** `board` is an integer containing the board handle.

`ren` specifies whether the REN line is to be asserted or unasserted. If `ren` is zero, the REN line is unasserted. Otherwise, the REN line is asserted.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. The ESAC error is generated if the specified GPIB interface board is not the system controller. Contains the previous REN state if no error occurs.

**Usage Notes** This routine can only be used if the specified GPIB interface board is the system controller.

Even though the REN line is asserted, the device(s) is not put into remote state until is addressed to listen by the Active Controller. When the REN line is unasserted, *all devices* return to local control.

**Example** This example puts the device at MLA 12 (2C hex, ASCII ,) and associated with GPIB Interface Board 1 in remote mode.

BASIC
```
CALL ibfind ("GPIB1", gpib%)
CALL ibsre (gpib1%, 2)       ' You can use any non-zero value
CALL ibcmd (gpib1%, ",")
```

C
```
int gpib1:
gpib1 = ibfind ("GPIB1");
ibsre (gpib1, 2);            /* Use any non-zero value */
ibcmd (gpib1,",", 1);
```

PASCAL
```
var
    gpib1: integer;
begin
    gpib1 := ibfind ('GPIB1');
    ibsre (gpib1, 2);
    ibcmd (gpib1, ",", 1);
```

## IBSRQ (C only)

**Purpose** Defines the user-written service routine to be executed upon detection of SRQ.

**Syntax**

`BASIC` Not applicable

`C` `ibsrq (void (far *func) (void) )`

`PASCAL` Not applicable

**Parameters** `func` is the procedure to call whenever the SRQI bit is set (= 1) in `ibsta`. If `func` = NULL, then SRQ servicing is disabled.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** Automatic serial polling must be disabled in order to use this routine.

The SRQI bit in `ibsta` is checked after each call to the handler is made. If the SRQI bit = 1, then the `func` routine is called before control is returned to the application program.

**Example** Define the routine to be called when SRQI is set (=1).

`BASIC` Not Applicable

`C`

```
int plotter;
main ()
    {
    int gpib1 = ibfind ("gpib1");
    /*disable autopolling */
    ibconfig (gpib1, ibcAUTOPOLL, 0);
    plotter = ibfind ("DEVICE5");
    ibsrq (srqroutine);
    }
void far srqroutine ()
    {
    char spr;
    ibrsp (plotter, &spr);
    /* analyze spr here */
    }
```

`PASCAL` Not Applicable

## IBSTOP

**Purpose** Terminate an asynchronous operation.

**Syntax**

BASIC `CALL ibstop (boarddev%)`

C `ibstop (int boarddev)`

PASCAL `ibstop (boarddev:integer)`

**Parameters** `boarddev` is an integer containing the device or board handle.

**Returns** `ibsta` will contain a 16-bit status word as described in "Appendix B. If an operation is terminated, the `EERR` bit is set.

`iberr` will contain an error code, if an error occurred. If an operation is terminated, an `EABO` error is returned.

**Usage Notes** If a *device* is specified, all unfinished asynchronous operations (read, write, or command) associated with that device is stopped. If a *GPIB Interface Board* is specified, all unfinished asynchronous operations associated with that board is stopped. Once the operation(s) have been terminated, the application is resynchronized with the driver.

**Example** This example starts a background write command and then immediately stops it.

BASIC
```
CALL ibfind ("DEV2", dev%)
CALL ibwrta (dev%, "datafile")
CALL ibstop (dev%)
```

C
```
int dev;
dev = ibfind ("DEV2");
ibwrta(dev, "datafile");
ibstop (dev);
```

PASCAL
```
var
    dev: integer;
begin
    dev:= ibfind ('DEV2');
    ibwrta (dev, 'datafile');
    ibstop (dev);
```

## IBTMO

**Purpose** Changes timeout value.

**Syntax**

BASIC
```
CALL ibtmo (boarddev%, timeout%)
```

C
```
int ibtmo (int boarddev, int timeout)
```

PASCAL
```
ibtmo (boarddev:integer; timeout:integer)
```

**Parameters** `boarddev` is an integer containing device/board handle.

`timeout` specifies the timeout. The timeout value determines how long I/O routines wait for a response from a device. When the timeout period expires during an I/O operation, the I/O function returns an `EABO` error. Valid timeout codes are shown in Table 4-5.

Table 4-5. Timeout codes

| Code | Value | Minimum timeout | Code | Value | Minimum timeout |
|---|---|---|---|---|---|
| TNONE | 0 | Disabled | T100ms | 9 | 100 msec |
| T10us | 1 | 10 μsec | T300ms | 10 | 300 msec |
| T30us | 2 | 30 μsec | T1s | 11 | 1 sec |
| T100us | 3 | 100 μsec | T3s | 12 | 3 sec |
| T300us | 4 | 300 μsec | T10s | 13 | 10 sec |
| T1ms | 5 | 1 msec | T30s | 14 | 30 sec |
| T3ms | 6 | 3msec | T100s | 15 | 100 sec |
| T10ms | 7 | 10msec | T300s | 16 | 300 sec |
| T30ms | 8 | 30 msec | T1000s | 17 | 1000 sec |

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. Contains the previous timeout code if no error occurs.

**Usage Notes** This routine is used to temporarily change the default timeout value assigned to the device/GPIB Interface board.

The new timeout is used until it is redefined (by calling `ibtmo` again) the device/board is re-initialized (by calling `ibfind` or `ibonl`); or the system is restarted.

**Example** This example changes the timeout (to 30 sec) for all calls specifying the "plotter" device.

BASIC
```
CALL ibfind("PLOTTER", plotter%)
CALL ibtmo (plotter%, T30us)
```

C
```
int plotter;
plotter = ibfind ("PLOTTER");
ibtmo(plotter, T30us);
```

PASCAL
```
var
   plotter: integer;
begin
   plotter := ibfind ('PLOTTER');
   ibtmo(plotter, T30us);
```

## IBTRG

**Purpose** Triggers the specified device.

**Syntax**

BASIC `CALL ibtrg (device%)`

C `ibtrg (int device)`

PASCAL `ibtrg (device:integer)`

**Parameters** `device` is an integer containing device handle.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this routine is executed, the GPIB Interface Board associated with the device is addressed to talk and all devices are unlistened. The specified device is then addressed to listen and a GET (Group Execute Trigger) command is sent.

**Example** This example triggers the specified device.

BASIC
```
CALL ibfind ("DEVICE6", plotter%)
CALL ibtrg (plotter%)
```

C
```
int plotter;
plotter = ibfind ("DEVICE6");
ibtrg (plotter);
```

PASCAL
```
var
    plotter: integer;
begin
    plotter := ibfind ('DEVICE6');
    ibtrg (plotter);
```

## IBWAIT

**Purpose** Forces application program to wait for a specified event(s) to occur.

**Syntax**

BASIC `CALL ibwait (boarddev%, mask%)`

C `ibwait (int boarddev, int mask)`

PASCAL `ibwait (boarddev:integer; mask:word)`

**Parameters** `boarddev` is an integer containing the device/board handle.

`mask` specifies the events that `ibwait` will wait for. Each bit in mask represents a different event. These bits are the same as the bits in `ibsta` positions.

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|---|
| | | TIMO | EEND | SRQI | RQS | SPOLL | EEVENT | CMPL |

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | LOK | RREM | CIC | AATN | TACS | LACS | DTAS | DCAS |

For more information regarding `ibsta`, see Appendix C.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** Because the mnemonic for each bit of `ibsta` is defined as a constant within the header file, you can elect to use the mnemonic rather than the hex value. For example, these two BASIC/QuickBASIC calls are equivalent:

```
IF IBSTA% AND TIMO THEN PRINT "TIMEOUT"
```

or

```
IF IBSTA% AND &H4000 THEN PRINT "TIMEOUT"
```

This routine also updates `ibsta`. If `mask=0`, the routine returns immediately with an update of `ibsta`.

If the `TIMO` bit is 0 or a previous `ibtmo` specifies a time limit of 0, timeouts are disabled. This should only be done when setting `mask = 0` , or when it is certain the selected event will occur. Otherwise, the processor may wait indefinitely for the event to occur.

If a device is specified, only `TIMO`, `EEND`, `RQS`, and `CMPL` are applicable.

If automatic polling is enabled, and `RQS` is specified by `ibwait`, each time the SRQ line is asserted the GPIB Interface Board associated with the specified device will serial poll all devices on its bus and save the responses. This continues until the status byte returned by the device specified by `ibwait`, indicates that it was the device requesting service.

If `TIMO` is set, `ibwait` returns if the event does not occur withn the timeout period of the device.

If a GPIB interface board is specified, the `RQS` bit is not applicable.

**Example** This example forces your program to wait indefinitely for the specified device to request service.

BASIC
```
CALL ibfind ("DEVICE7", plotter%)
CALL ibwait (plotter%, RQS)
```

C
```
int plotter;
plotter = ibfind ("DEVICE7");
ibwait (plotter, RQS);
```

PASCAL
```
var
    plotter: integer;
begin
    plotter := ibfind ('DEVICE7');
    ibwait (plotter, RQS);
```

## IBWRT

**Purpose** Writes data from a string to the specified device or GPIB Interface Board.

**Syntax**

BASIC `CALL ibwrt (boarddev%, buf$)`

C `ibwrt (int boarddev, char buf[], unsigned long bytecount)`

PASCAL `ibwrt(boarddev:integer;varbuf;bytecount:longint)`

**Parameters** `boarddev` is an integer containing the device/board handle.

`buf` is the string containing the data to be written. `buf` can contain up to 4 gigabytes-1 ($2^{32}$-1 bytes). String size may be limited by the language you are using. Check documentation for your language.

`bytecount` specifies the number of bytes to be written from the string.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code of the first error detected, if an error occurred. An `EADR` results if boarddev specifies a board and the board has not already been addressed to talk.

`ibcnt, ibcntl` will contain the number of bytes that were written. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

**Usage Notes** This routine is used to send device-specific commands. A write terminates when one of the following occurs:

- All bytes are transferred.
- An error is detected.
- The time limit is exceeded.
- A DCL (Device Clear) or SDC (Selected DC) is received from the CIC.
- All data is sent.

If `boarddev` specifies a device, the specified device is addressed to listen and its associated access board is addressed to talk. If `boarddev` specifies a GPIB Interface Board, the Controller-In-Charge must have already addressed a device as a listener and the board as a talker. If the board is the Active Controller, it unasserts `ATN` in order to send data. This routine leaves the board in that state.

If you want to send an EOS character at the end of the data string, you must include it in the string.

**Example** This example sends five bytes terminated by a carriage return and line feed to the specified device.

```
BASIC  CALL ibfind ("DEVICE7", ptr%)
       wrt$ = "IP2X5" + chr$(&H0D) + chr$(&H0A)
       CALL ibwrt(ptr%, wrt$)

C      int ptr;
       ptr = ibfind ("DEVICE7");
       ibwrt (ptr,"IP2X5\r\n", 7);

PASCAL var
          ptr: integer;
       begin
          ptr := ibfind ('DEVICE7');
          ibwrt (ptr, 'IP2X5#13#10', 7);
```

## IBWRTA

**Purpose**

Writes data asynchronously from a string to the specified device or GPIB interface board.

**Syntax**

BASIC
```
CALL ibwrta (boarddev%, buf$)
```

C
```
ibwrta (int boarddev, char buf[], unsigned long bytecount)
```

PASCAL
```
ibwrta (boarddev:integer; var buf; bytecount: longint)
```

**Parameters**

`boarddev` is an integer containing the device/board handle.

`buf` is the storage buffer for the data. Up to 4 gigabytes-1 ($2^{32}$-1 bytes) can be stored. String size may be limited by the language you are using. Check documentation for your language.

`bytecount` specifies the number of bytes to be written.

**Returns**

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code of the first error detected, if an error occurred. An EADR results if `boarddev` specifies a board and the board has not already been addressed to talk.

`ibcnt`, `ibcntl` will contain the number of bytes that were written. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

**Usage Notes**

A write terminates when one of the following occurs:

- An error is detected.
- The time limit is exceeded.
- A DCL (Device Clear) or SDC (Selected DC) is received from the CIC.
- All data is sent.

If `boarddev` specifies a device, the specified device is addressed to talk and its associated access board is addressed to listen.

If `boarddev` specifies a GPIB Interface board, you must have already addressed a device as a listener and the board as a talker. If the board is the Active Controller, it unasserts `ATN` in order to send data. This routine leaves the board in that state.

This command is normally only used for very large data transfers. It allows the program to continue running in the foreground while the data transfer continues in the background. For small data transfers, use `ibwrt`.

Small data transfers are very quick. In those cases it is simpler to use `ibwrt` instead of `ibwrta`.

**Example**

In this example, `ibwrt` sends a command ("UPLOAD") to a device. The device expects a block of data to be sent immediately. `ibwrta` begins a transfer of 5000 bytes in the background and program continues on into the WHILE loop. The WHILE loop calls `ibwait` with MASK set to 0 to update `ibsta`. The WHILE loop checks `ibsta` to see if `ibwrta` has completed or any error have occurred. The program may do anything else within the WHILE loop except make other GPIB I/O calls.

```
BASIC  writebuffer$ = space(5000)
       CALL ibwrt (device%, "UPLOAD")
       CALL ibwrta (device%, writebuffer$)
       WHILE (ibsta% AND CMPL+EERR) = 0
           ' Check for complete or error
           ibwait (device%, 0)
           ' Other code may be inserted here
       WEND
```

```
C       char writebuffer[5000];
        ibwrt (device, "UPLOAD")
        ibwrta (device, writebuffer, 5000);
        while ( (ibsta & CMPL+EERR) == 0)
            ibwait (device, 0)
```

```
PASCAL type
            buf = array [1...5000] of char;
        var
            wrtbuffer: buf;
        begin
            ibwrt (device, 'UPLOAD');
            ibwrta (device, writebuffer, 5000);
            while ibsta and (CMPL+EERR) = 0 do
                ibwait (device, 0);
```

## IBWRTF

**Purpose** Writes data from a file to the specified device or GPIB Interface Board.

**Syntax**

BASIC `CALL ibwrtf(boarddev%, filename$)`

C `ibwrtf (int boarddev, char filename [])`

PASCAL `ibwrtf (boarddev:integer; var filename:flbuf)`

**Parameters** `boarddev` is an integer containing the device/board handle.

`filename` is the name of the file (up to 50 characters, including drive/path) to store the data. Specify a drive and path if necessary. This file is automatically opened as a binary file.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. An EFSO error is generated if the file can not be found.

`ibcnt, ibcntl` will contain the number of bytes that were written. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

**Usage Notes** A write terminates when one of the following occurs:

- An error is detected.
- The time limit is exceeded.
- A DCL or SDC is received from the Active Controller.
- All data has been sent.

If `boarddev` specifies a *device*, the specified device is addressed to talk and its associated access board is addressed to listen. If `boarddev` specifies a *GPIB interface board*, you must have already addressed a device as a listener and the board as a talker. If the board is the CIC, it unasserts ATN in order to receive data. This routine leaves the board in that state.

**Example** This program sends the command "UPLOAD" to a device and prepares the device to recieve a large amount of data. The program then sends the data from a file to the device.

BASIC
```
CALL ibwrt (device%, "UPLOAD")
CALL ibwrtf (device%, "c:gpib.dat")
```

C
```
int device;
ibwrt (device, "UPLOAD");
ibwrtf (device, "c:gpib.dat");
```

PASCAL
```
var
    device : integer;
begin
    ibwrt (device, 'UPLOAD');
    ibwrtf (device, 'c:gpib.dat');
```

## IBWRTI (QuickBASIC, BASIC only)

**Purpose** Writes data from an integer array.

**Syntax**

| | |
|---|---|
| BASIC | CALL ibwrti(boarddev%, iarr%(), bytecount&) |
| C | Not Supported |
| PASCAL | Not Supported |

**Parameters** `boarddev` is an integer containing the device/board handle.

`iarr` is the integer array that is written to the device.

`bytecount` specifies the number of bytes to be written.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`ibcnt, ibcntl` will contain the number of bytes that were written. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

`iberr` will contain an error code of the first error detected, if an error occurred. An `EADR` results if the `boarddev` specifies a board and the board has not already been addressed to talk.

**Usage Notes** As data is written, each byte pair is treated as an integer.

C and PASCAL users should use `ibwrt` for both strings and integers.

**Example** This example writes 90 bytes of data from a device address at MTA 15 (hex 4F, ASCII 0) to GPIB Board 1. The GPIB board's listen address is MLA 1. (hex 21, ASCII !).

```
BASIC   DIM iarr%(90)
        CALL ibfind ("GPIB1", brd1%)
        CALL ibcmd (brd1%, "?0!")
        CALL ibwrti (brd1%, iarr%(), 90)

C       Not Supported

PASCAL  Not Supported
```

## IBWRTIA (QuickBASIC, BASIC only)

**Purpose** Writes data asynchronously data from an integer array.

**Syntax**

BASIC `CALL ibwrtia(boarddev%, iarr%(), bytecount&)`

C `Not Supported`

PASCAL `Not Supported`

**Parameters** `boarddev` is an integer containing the device/board handle.

`iarr` is the integer array which is written to the device. The array can be of type single, double, or long. `iarr` *can not be a dynamic array*.

`bytecount` specifies the maximum number of bytes to be written.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`ibcnt, ibcntl` will contain the number of bytes that were written. `ibcnt` is a 16-bit integer. `ibcntl` is a 32-bit integer. If the requested count was greater than 64 K, use `ibcntl` instead of `ibcnt`.

`iberr` will contain an error code of the first error detected, if an error occurred. An `EADR` results if `boarddev` specifies a board and the board has not already been addressed to talk.

**Usage Notes** As data is written, each byte pair is treated as an integer.

Once an asynchronous I/O call has begun, any further calls to a GPIB library routine, except for `ibwrt` and those functions which do not specify a device or GPIB Interface Board, cannot be executed until the I/O has finished and the GPIB driver and the application have been re-synchronized. This is accomplished by calling one of the following:

`ibwait` The driver and applications are synchronized (mask contains CMPL).

`ibstop` The asynchronous I/O is canceled, and the driver and application are synchronized.

`ibonl` The asynchronous I/O is canceled, the interface has been reset and the driver and application are synchronized.

Re-synchronization is successful if a CMPL is returned to `ibsta`. See Appendix C.

C and Pascal users should use `ibwrta`.

**Example** This example writes 90 bytes of data from a device address at MTA 15 (hex 4F, ASCII 0) to GPIB Board 1. The GPIB board's listen address is MLA 1. (hex 21, ASCII !).

```
BASIC   DIM iarr%(90)
        CALL ibfind("GPIB1", brd1%)
        CALL ibcmd (brd1%, "?0!")
        CALL ibwrtia (brd1%, iarr%(), 90)

C       Not Supported

PASCAL  Not Supported
```

# GPIB-488.2 Library Reference

This chapter describes each of the GPIB-488.2 routines. Each description provides a brief definition of the routine, its syntax, parameters, and any values which are returned. Any special usage notes and an example of are also given. The routines are listed in alphabetical order. Table 5-1 lists the GPIB-488.2 routines.

Table 5-1. GPIB-488.2 routines

| Name | Description |
|---|---|
| AllSpoll | Serial polls all devices |
| DevClear | Clears a single device |
| DevClearList | Clears multiple devices |
| EnableLocal | Enables local programming of a device |
| EnableRemote | Enables remote programming of a device |
| FindLstn | Find all Listeners |
| FindRQS | Find device requesting service |
| PassControl | Make another device the Active Controller |
| PPoll | Conduct a parallel poll |
| PPollConfig | Configure a device for parallel polls |
| PPollUnconfig | Unconfigure devices for parallel polls |
| RcvRespMsg | Read data from a previuosly addressed GPIB device |
| ReadStatusByte | Serial poll a single device |
| Receive | Read data from a GPIB device |
| ReceiveSetup | Address device as talker and GPIB Interface Board as Listener |
| ResetSys | Initialize a GPIB system |
| Send | Send data to one device |
| SendCmds | Send GPIB commands |
| SendDataBytes | Send data to previously addressed GPIB devices |
| SendIFC | Assert the IFC line |
| SendList | Send data to multiple GPIB devices |
| SendLLO | Send Local Lockout (LLO) to all devices |
| SendSetup | Prepare devices to receive data |
| SetRWLS | Put devices in Remote with Lockout state |
| TestSRQ | Determine status of SRQ line |
| TestSys | Force devices to conduct self-tests |
| Trigger | Trigger a single device |
| TriggerList | Trigger multiple devices |
| WaitSRQ | Wait until a device asserts SRQ |

**Note**

488.2 addresses contain two bytes packed into a word – the low byte is the primary address and the high byte is the secondary address. If secondary addressing is not used, the high byte should be zero.

Table 5-2. 488.2 Address word

| HIGH BYTE | LOW BYTE |
|---|---|
| Secondary Address (0 or 96-126) | Primary Address (0-30) |

488.2 routines use a board index as the first argument (typically zero) – not a handle.

## AllSpoll

**Purpose** Performs a serial poll on specified devices.

**Syntax**

BASIC
```
Call AllSpoll (board%, addresslist%(), resultlist%())
```

C
```
AllSpoll (int board, short addresslist[],
short resultlist[])
```

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to be serial polled.

**Returns** `resultlist` is an arraywhich contains the results of the serial poll. Once a device has been serial polled, the results of the serial poll are stored in the corresponding element of `resultlist`.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. If a device times out, `iberr` contains Error 6 – `EABO` (see Appendix C), and `ibcnt` contains the isndex of the timed-out device.

**Usage Notes** To poll only one GPIB device, use `ReadStatusByte`.

**Example** This example serial polls two devices (GPIB address 6 and 7) connected to GPIB board 0.

BASIC
```
DIM addresslist%(3)
DIM resultlist%(2)
addresslist% (0) = 6
addresslist% (1) = 7
addresslist% (2) = NOADDR
CALL AllSpoll(0,addresslist%(),resultlist%())
```

C
```
short addresslist[3] = {6,7,NOADDR};
short resultlist[2];
AllSpoll (0, addresslist, resultlist);
```

## DevClear

**Purpose** Clears one device.

**Syntax**

BASIC `CALL DevClear(board%, address%)`

C `DevClear(int board, short address)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`address` is the GPIB address of the device to clear.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This routine sends the GPIB Selected Device Clear (SDC) message to the specified device.

To clear multiple devices, use the `DevClearList` routine.

If `address` is set to `NOADDR`, then all connected devices on the GPIB is cleared via the Universal Device Clear (UDC) message.

**Example** This example clears the device at GPIB primary address 4, secondary address 30 connected to GPIB board 0.

```
BASIC   address% = 4 + 256*30
        `CALL DevClear (0, address%)

C       DevClear(0, MakeAddr (4,30));
        /* Use MakeAddr macro (in WINDECL.H) to pack primary and secondary address */
```

## DevClearList

**Purpose** Clears specified devices.

**Syntax**

BASIC `CALL DevClearList(board%, addresslist%())`

C `DevClearList(int board, short addresslist[])`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to be cleared.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This routine sends the GPIB Selected Device Clear (SDC) to the devices specified by `addresslist`.

To clear all devices in BASIC/QuickBASIC, use an array containing only the `NOADDR` value. To clear all devices in C, pass a NULL value. This sends the GPIB the Universal `Device Clear` (DCL) message.

To clear only one device, use `DevClear`.

**Example** This clears the devices at GPIB addresses 6 and 7, connected to GPIB board 0.

```
BASIC   DIM addresslist%(3)
        addresslist% (0) = 6
        addresslist% (1) = 7
        addresslist% (2) = NOADDR
        CALL DevClearList(0, addresslist% ())

C       short addresslist[3] = {6,7,NOADDR};
        DevClearList(0, addresslist);
```

## EnableLocal

**Purpose** Places specified devices in local mode (Can be "programmed" from front panel controls.).

**Syntax**

BASIC `CALL EnableLocal(board%, addresslist%())`

C `EnableLocal(int board, short addresslist[])`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to enable locally.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this routine is executed, the Controller addresses the specified GPIB devices as listeners and then sends the GPIB `Go To Local` (GTL) command.

To put all devices in local mode, use an array containing only the `NOADDR` value. This unasserts the GPIB `Remote Enable` (REN) line, thereby placing all GPIB devices in local mode.

**Example** Put the GPIB devices at addresses 6 and 7 (connected to board 0) in local mode.

```
BASIC  DIM addresslist%(3)
       addresslist% (0) = 6
       addresslist% (1) = 7
       addresslist% (2) = NOADDR
       CALL EnableLocal (0, addresslist% ())

C      short addresslist[3] = {6,7,NOADDR};
       EnableLocal(0, addresslist);
```

## EnableRemote

**Purpose** Allow remote programming (by sending messages over the GPIB line) of a device.

**Syntax**

BASIC `CALL EnableRemote(board%, addresslist%())`

C `EnableRemote(int board, short addresslist[])`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to be put in remote programming mode.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this routine is executed, the system controller asserts the Remote Enable (REN) line and the Controller addresses the specified devices as listeners.

**Example** Places devices at GPIB addresses 6 and 7 (connected to GPIB board) in remote mode.

```
BASIC   DIM addresslist%(3)
        addresslist% (0) = 6
        addresslist% (1) = 7
        addresslist% (2) = NOADDR
        CALL EnableRemote (0, addresslist% ())

C       short addresslist[3] = {6,7,NOADDR};
        EnableRemote(0, addresslist);
```

## FindLstn

**Purpose** Finds all listeners on the GPIB.

**Syntax**

BASIC `CALL FindLstn(board%,addresslist%(),resultlist%(), limit%)`

C `FindLstn(int board, short addresslist[], short resultlist[], int limit)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`.

`limit` is an integer which specifies how many address entries can be placed into the `resultlist` array. Set to the size of the `resultlist` array.

**Returns** `resultlist` will contain the addresses of all detected listeners. This array must be large enough to hold all possible addresses.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. An `ETAB` (20) error indicates that more listeners are present on the GPIB bus than `limit` will allow to be placed in `resultlist`. In this case, `ibcnt` contains the number of addresses actually placed in `resultlist`.

**Usage Notes** The addresses specified by `addresslist` are tested to see if a listening device is present. If a listener is found at a primary address, its address is placed in `resultlist`. If no listeners are detected at a primary address, then all secondary addresses associated with that primary address are tested. If any listeners are detected, their addresses are placed in `resultlist`. You can use this routine to determine how many devices on the network are capable of listening. Once these devices are detected, they can be identified by their response to identification request messages.

**Example** This example verifies if listening devices are present at GPIB primary addresses 6 and 7 on Board 0.

```
BASIC   DIM addresslist%(3)
        DIM resultlist%(4)addresslist% (0) = 6
        addresslist% (1) = 7
        addresslist% (2) = NOADDR
        limit% = 4
        CALL FindLstn(0,addresslist%(),resultlist%(), limit%)

C       short addresslist[3] = {6,7,NOADDR};
        short resultlist[4];
        FindLstn(0, addresslist, resultlist, 4);
```

## FindRQS

**Purpose** Identify the device requesting service.

**Syntax**

BASIC `CALL FindRQS(board%, addresslist%(), result%)`

C `FindRQS(int board, short addresslist[], short *result)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. The devices located at these addresses are serial polled until the one asserting SRQ is located.

**Returns** `result` will contain the returned status byte of the device asserting SRQ.

`ibcnt` will contain the index ( in `addresslist`) identifying the device's address.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred. `iberr` contains the error code ETAB, if no device is requesting service. In this case, `ibcnt` contains `NOADDR`'s index.

`iberr` will contain the error code EABO, if a device times out while responding to its serial poll. In this case, `ibcnt` contains the index of the timed-out device.

**Usage Notes** None.

**Example** Identifies which of the devices at GPIB addresses 6 and 7 (connected to board 0) is requesting service.

```
BASIC   DIM addresslist%(3)
        addresslist% (0) = 6
        addresslist% (1) = 7
        addresslist% (2) = NOADDR
        CALL FindRQS(0, addresslist% (), result%)

C       short addresslist[3] = {6,7,NOADDR};
        short result;
        FindRQS (0, addresslist, &result);
```

## PassControl

**Purpose** Makes another device the Active Controller.

**Syntax**

BASIC `CALL PassControl(board%, address%)`

C `PassControl(int board, short address)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`address` is an integer representing the GPIB address of the device that is to become the controller. The low byte of the integer contains the device's primary GPIB address. The high byte of the address contains the device's secondary GPIB address. If the device has no secondary address, the high byte of `address` is 0.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this routine is executed, the GPIB Take Control (TCT) command is issued. This forces the Active Controller to pass control to the device at the specified address. This device must have Controller capability.

**Example** This example would make the device connected to Board 0 and whose GPIB address is 6 the Active Controller.

```
BASIC      address% = 6
           CALL PassControl(0, address%)

C          PassControl(0, 6);
```

## Ppoll

**Purpose** Performs a parallel poll.

**Syntax**

BASIC `CALL PPoll(board%, result)`

C `PPoll(int board, short *result)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

**Returns** `result` will contain the eight-bit result of the parallel poll. Each bit of the poll result contains one bit of status information from each device which has been configured for parallel polls. The value of each bit is dependent on the latest parallel poll configuration sent to the devices via `PPollConfig` and the individual status of the devices.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage notes** None.

**Example** Parallel polls devices connected to board 0.

```
BASIC  CALL PPoll(0, result%)

C      short result;
       PPoll(0, &result);
```

## PPollConfig

**Purpose** Configures a device for parallel polls.

**Syntax**

BASIC
```
CALL PPollConfig(board%, address%, dataline%, sense%)
```

C
```
PPollConfig(int board, short address, int dataline,
int sense)
```

**Parameters**

`board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`address` is the address of the GPIB device to be configured for a parallel poll.

`dataline` specifies which data line (1-8) the device uses to respond to a parallel poll.

`sense` can be 1 or 0, specifying the condition under which the data line is to be asserted/unasserted. The device compares this value to its Individual Status Bit (IST) and then responds accordingly. For example, if `sense = 0` and the device asserts the specified data line if its IST bit = 0 and unassert the data line if its IST bit = 1.

**Returns**

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage notes** Remember that if a device is locally configured for a parallel poll, the Controller's parallel poll configuration instruction is ignored.

**Example** Configures the device connected to board 0 at address 6 to respond to parallel polls on line 7 with sense 1. The device asserts line 7 if its IST bit = 1, and unasserts line 7 if IST = 0.

BASIC
```
Call PpollConfig(0, 6, 7, 1)
```

C
```
PPollConfig(0, 6, 7, 1)
```

## PPollUnconfig

**Purpose** Unconfigures devices for parallel polls.

**Syntax**

BASIC `CALL PPollUnconfig(board%, addresslist%())`

C `PPollUnconfig(int board, short addresslist[])`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices that do not respond to a parallel poll.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** To unconfigure all devices, in BASIC use an array containing only the `NOADDR` value. This sends the GPIB Parallel Poll Unconfigure (PPU) command.

**Example** Unconfigure the devices connected to board 0 and located at GPIB addresses 6 and 7.

```
BASIC   DIM addresslist%(3)
        addresslist% (0) = 6
        addresslist% (1) = 7
        addresslist% (2) = NOADDR
        CALL PPollUnconfig(0, addresslist% ())

C       short addresslist[3] = {6, 7, NOADDR};
        PPollUnconfig(0, addresslist);
```

## RcvRespMsg

**Purpose** Reads data from a previously addressed device.

**Syntax**

BASIC
```
CALL RcvRespMsg(board%, data$, termination%)
```

C
```
RcvRespMsg(int board, char data[], long count,
int termination)
```

**Parameters**

`board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`count` specifies the maximum number of data bytes which are to be read. This parameter is not required in BASIC, since `count` is set to the length of the data string.

`termination` is the flag used to signal the end of data. If `termination` equals a value between 0 and 00FF hex, the corresponding ASCII character is the termination character. The read is stopped when this character is detected. If `termination = STOPend` (A constant defined in the header file.), then the read is stopped when EOI is detected.

**Returns**

`data` is the string that receives the data. In BASIC, it is important that you allocate a large enough string to accomodate all of the data.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** You must address the appropriate devices as Listeners/Talkers prior to calling this routine. The input data string is `not` terminated with a zero byte.

**Example** A previously addressed Listener receives 50 bytes of data from a previously addressed Talker. The transmission is terminated when EOI is detected.

```
BASIC   DIM data AS STRING*50
        CALL RcvMsgResp(0, data, STOPend)

C       char data[50];
        RcvRespMsg(0, data, 50, STOPend)
```

## ReadStatusByte

**Purpose** Serial poll a single device and read its status byte.

**Syntax**

BASIC `CALL ReadStatusByte(board%, address%, result%)`

C `ReadStatusByte(int board, int address, short *result)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`address` is an integer representing the GPIB address of the device that is to be serial polled.

**Returns** `result` will contain the status byte. The high byte of `result` is always 0.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** None.

**Example** This example serial polls the device at address 2 and retrieves its status byte.

```
BASIC  CALL ReadStatusByte (0, 2, result%)

C      short result;
       ReadStatusByte (0, 2, &result);
```

## Receive

**Purpose** Reads data from a GPIB device.

**Syntax**

BASIC
```
CALL Receive(board%, address%, data$, termination%)
```

C
```
Receive(int board, int address,char data[],
unsigned long count, int termination)
```

**Parameters**

`board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`address` is an integer representing the GPIB address of the device that is to be read from.

`count` specifies the maximum number of data bytes which are to be read. This parameter is not required in BASIC, since `count` is set to the string length of the data.

`termination` is the flag used to signal the end of data. If `termination` equals a value between 0 and 00FF hex, the corresponding ASCII character is the termination character. The read is stopped when this character is detected. If `termination = STOPend` (constant defined in the header file), then the read is stopped when EOI is detected.

**Returns**

`data` is the string that receives the data. In BASIC, it is important that you allocate a large enough string to accomodate all of the data.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** The input data string is `not` terminated with a zero byte.

**Example** Receive 50 bytes of data from the specified talker (device at address 2, connected to board). EOI signals the end of the message.

```
BASIC  data$ = space$(50)
       CALL Receive (0, 2, data$, STOPend)

C      char data[50];
       Receive (0, 2, data, 50, STOPend);
```

## ReceiveSetup

**Purpose** Address a GPIB Interface Board as a Listener and a GPIB device as a Talker, in preparation for data transmission.

**Syntax**

BASIC `CALL ReceiveSetup(board%, address%)`

C `ReceiveSetup(int board, short address)`

**Parameters** `board` An integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`address` is an integer representing the GPIB address of the device to send the data.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** In order to actually transfer any data, you must call a routine such as `RcvRespMsg` following this routine.

This routine is useful in instances where you need to transfer multiple blocks of data between devices. For example, you could initially address the devices using `ReceiveSetup`, then make multiple calls of `RcvRespMsg` to transfer the data.

For typical cases, `Receive` is simpler to use, since it takes care of both the setup and the data transfer.

**Example** This example instructs a GPIB device at address 5 to send data to GPIB Board 0. Up to 50 bytes of data is received and then stored in a string. The message is terminated with an EOI.

```
BASIC   DIM message AS STRING*50
        CALL ReceiveSetup(0, 5)
        CALL RcvRespMsg(0, message, STOPend)

C       char message[100];
        ReceiveSetup(0, 5);
        RcvRespMsg (0, message, 50, STOPend);
```

## ResetSys

**Purpose** Initializes GPIB System.

**Syntax**

BASIC `CALL ResetSys(board%, addresslist%())`

C `ResetSys(int board, short addresslist[])`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices on the system to be reset.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This routine initializes the GPIB bus and all specified devices. First, the system controller asserts the REN (Remote Enable) line and then the IFC (Interface Clear) line. This action unlistens and untalks all of the attached GPIB devices and causes the system controller to become the Controller-In-Charge (CIC).

The Device Clear (DCL) message is then sent to all of the connected devices. This forces the devices to return to their default states and ensures that they can receive the Reset (RST) message. A reset message (RST) is then sent to all of the devices specified by `addresslist`. This resets the devices to specific parameters.

**Example** This example resets the GPIB devices connected to GPIB board 0 and assigned GPIB bus addresses of 6 and 7.

```
BASIC   DIM addresslist%(3)
        addresslist% (0) = 6
        addresslist% (1) = 7
        addresslist% (2) = NOADDR
        CALL ResetSys (0, addresslist%())

C       short addresslist[3] = {6, 7, NOADDR};
        ResetSys(0, addresslist);
```

## Send

**Purpose** Sends data to one GPIB device.

**Syntax**

BASIC
```
CALL Send(board%, address%, data$, eotmode%)
```

C
```
Send (int board, short address,char data[],
long count, int eotmode)
```

**Parameters**

`board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`address` is an integer representing the GPIB address of the device to receive the data.

`data` is the string of data which is sent to the device.

`count` specifies the maximum number of data bytes which are to be sent to the device. This parameter is not required in BASIC, since `count` is set to the string length of the data.

`eotmode` is the flag used to signal the end of data.

**Returns**

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes**

When this routine is executed, the specified GPIB board is addressed as a Talker, the designated GPIB device is addressed as a Listener and the number of bytes (specified by `count`) in `data` is sent. Values for `eotmode` are:

- `NLend` - Send NL (Line Feed) with EOI after last data byte.
- `DABend` - Send EOI with the last data byte in the string.
- `NULLend` - Do not mark the end of the transfer.

These constants are defined in the header file.

**Example** In this example, GPIB board 0 sends an identification query to the GPIB device at address 3. End of data is signalled by an EOI.

BASIC
```
Call Send (0, 3, "*IDN?", DABend)
```

C
```
Send (0, 3, "*IDN?", DABend)
```

## SendCmds

**Purpose** Send GPIB commands.

**Syntax**

BASIC
```
CALL SendCmds (board%, commands$)
```

C
```
SendCmds (int board, char commands[],
unsigned long count)
```

**Parameters**

`board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`commands` is a string containing the GPIB command bytes to be sent.

`count` specifies the maximum number of command bytes which are to be sent. This parameter is not required in BASIC, since `count` is set to the string length of the data.

**Returns**

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This routine is useful in situations where specialized GPIB command sequences are called for.

**Example** The GPIB board (at 0) simultaneously triggers the GPIB devices at addresses 8 and 9 and quickly puts them in local mode.

BASIC
```
CALL SendCmds(0, chr$(&3F)+chr$(&40)+chr$(&H2 8)
```

C
```
SendCmds0, "\x3F\x40\x28\x29\x04\x01",6);
```

## SendDataBytes

**Purpose** Sends data to previously addressed devices.

**Syntax**

BASIC `CALL SendDataBytes (board%, data$, eotmode%)`

C `SendDataBytes(int board, char data[], long count, int eotmode)`

**Parameters** `board` An integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`data` is the string that contains the data which is sent to the device.

`count` specifies the maximum number of data bytes which are to be sent to the device. This parameter is not required in BASIC, since `count` is set to the string length of the data.

`Eotmode` is the flag used to signal the end of data.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This routine assumes that the desired GPIB listeners have already been addressed (by using `SendSetup`, for example).

Values for `eotmode` are as follows:

- `NLend` - Send NL (Line Feed) with EOI after last data byte.
- `DABend` - Send EOI with the last data byte in the string.
- `NULLend` - Do not mark the end of the transfer.

These constants are defined in the header files.

**Example** In this example, GPIB board 0 sends an identification query to all previously addressed listeners. End of data is signaled by an EOI.

```
BASIC      Call SendDataBytes (0,"*IDN?", DABend)

C          SendDataBytes (0, "*IDN?", 5, DABend)
```

## SendIFC

**Purpose** Clears the GPIB bus by asserting the IFC (Interface Clear) line.

Syntax

| | |
|---|---|
| BASIC | `CALL SendIFC(board%)` |
| C | `SendIFC(int board)` |

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This routine is used as part of the GPIB initialization procedure. When the system controller asserts the IFC line, it unlistens and untalks all GPIB devices, forcing them to an idle state. The system controller also becomes the Controller-In-Charge (CIC).

**Example** Clears the GPIB bus from Board 0.

```
BASIC   CALL SendIFC(0)

C       SendIFC(0);
```

## SendList

**Purpose** Sends data to multiple GPIB devices.

**Syntax**

BASIC `CALL SendList(board%, addresslist(), data$, eotmode%)`

C `SendList(int board, short addresslist[], char data[], long count, int eotmode)`

**Parameters**

`board` is an integer which identifies the GPIB board to use for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices on the system to reset.

`data` is the string containing the data to send.

`count` specifies the maximum number of data bytes to send to the device. This parameter is not required in BASIC, since `count` is set to the string length of the data.

`eotmode` is the flag used to signal the end of data.

**Returns**

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes**

When this routine is executed, the specified GPIB board is addressed as a Talker and the designated GPIB devices as Listeners. The board then sends the given number of bytes of data from the `data` string to the listening GPIB devices.

Values for `eotmode` are as follows:

- `NLend` - Send NL (Line Feed) with EOI after last data byte.
- `DABend` - Send EOI with the last data byte in the string.
- `NULLend` - Do not mark the end of the transfer.

These constants are defined in the header files.

**Example**

In this example, GPIB board 0 sends an identification query to the GPIB devices at addresses 6 and 7. End of data is signalled by an EOI.

```
BASIC   DIM addresslist%(3)
        addresslist% (0) = 6
        addresslist% (1) = 7
        addresslist% (2) = NOADDR
        Call SendList0, addresslist%(), "*IDN?", DABend)

C       short addresslist%[3] = {6, 7, NOADDR};
        SendList (0, addresslist, "*IDN?", 5, DABend)
```

## SendLLO

**Purpose** Sends Local Lockout (LLO) message to all GPIB devices.

**Syntax**

BASIC `CALL SendLLO(board%)`

C `SendLLO(int board)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this routine is executed, the specified GPIB board sends the GPIB Local Lockout (LLO) message to all devices. This means that once they have been addressed as listeners, the devices respond only to messages sent over the GPIB by the Controller. (In other words, they can not be locally programmed from front panel controls.) Only the Controller can return them to a local programming state.

**Example** In this example, GPIB board 0 sends a Local Lockout to its connected GPIB devices.

```
BASIC      CALL SendLLO (0)

C          SendLLO (0);
```

## SendSetup

**Purpose** Addresses a GPIB board as a Talker and the specified GPIB devices as Listeners.

**Syntax**

BASIC `CALL SendSetup (board%, addresslist% ())`

C `SendSetup(int board, short addresslist [])`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to address as Listeners.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** Following this routine, you should call a routine such as `SendDataBytes` to actually transfer the data.

**Example** This example prepares GPIB board 0 to send data to GPIB devices 6 and 7.

```
BASIC  DIM addresslist%(3)
       addresslist%(0) = 6
       addresslist%(1) = 7
       addresslist%(2) = NOADDR
       CALL SendSetup(0, addresslist())

C      short addresslist[3] = {6, 7, NOADDR};
       SendSetup(0, addresslist);
```

## SetRWLS

**Purpose**

Puts all devices in Remote state with Local Lockout and addresses specified devices as Listeners.

**Syntax**

BASIC `CALL SetRWLS (board%, addresslist% ())`

C `SetRWLS(int board, short addresslist [])`

**Parameters**

`board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to be put in remote mode.

**Returns**

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes**

This routine puts the specified devices in remote mode with local lockout. The system controller asserts the REN (Remote Enable) line and addresses the specified devices as listeners. These devices can then be programmed by messages sent over the GPIB bus. (In other words, they can not be locally programmed from front panel controls.)

**Example**

This example puts all devices controlled by GPIB board 0 into Remote mode. Devices 6 and 7 are then addressed as Listeners by the Controller.

```
BASIC   DIM addresslist%(3)
        addresslist%(0) = 6
        addresslist%(1) = 7
        addresslist%(2) = NOADDR
        CALL SetRWLS(0, addresslist())

C       short addresslist[3] = {6, 7, NOADDR};
        SetRWLS(0, addresslist);
```

## TestSRQ

**Purpose** Evaluate state of SRQ line.

**Syntax**

BASIC `CALL TestSRQ (board%, result%)`

C `TestSRQ(int board, short *result)`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

**Returns** `result` is equal to 1 if the GPIB SRQ line is asserted. `result` = 0 if the GPIB SRQ line is unasserted.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** `TestSRQ` will not alter the state of the SRQ line.

**Example** This example tests to see if SRQ is asserted.

```
BASIC   CALL TestSRQ (0, result%)
        IF result% = 1 then
            'SRQ is asserted
        ELSE
            'No SRQ at this time
        END IF

C       Short result;
        TestSRQ (0, &result);
        if (result == 1)
            { /* SRQ is asserted */}
        else
            { /* No SRQ at this time */}
```

## TestSys

**Purpose** Activate self-test procedures of specified devices.

**Syntax**

BASIC `CALL TestSys (board%, addresslist% (), resultlist%())`

C
```
SendSetup(int board, short addresslist [],
short resultlist[])
```

**Parameters** `board` is an integer which identifies the GPIB board to use for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to perform self-tests.

**Returns** `resultlist` is an array which contaisn the results of each device's self-test procedure. According to the IEEE-488.2 standard, a result code of 0 indicates the device passed its test. Any other value indicates an error.

`ibcnt` will contain the number of devices which failed their tests.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this routine is executed, all of the devices identified within the `addresslist` array are concurrently sent a message which directs them to perform their self-test procedures. Each device returns an integer code indicating the results of its tests. This code is placed into the corresponding element of the `resultlist` array.

**Example** This example tells the devices at addresses 6 and 7 (from Board 0) to perform thier self-test procedures.

BASIC
```
DIM resultlist%(2)
DIM addresslist%(3)
addresslist%(0) = 6
addresslist%(1) = 7
addresslist%(2) = NOADDR
CALL TestSys(0, addresslist(), resultlist())
```

C
```
short addresslist[3] = {6, 7, NOADDR};
short resultlist[2];
TestSys(0, addresslist, resultlist);
```

## Trigger

**Purpose** Triggers one device.

**Syntax**

BASIC `CALL Trigger (board%, address%)`

C `Trigger(int board, short address)`

**Parameters** `board` is an integer which identifies the GPIB board to used for this operation. In most applications, this value is 0.

`address` is an integer representing the GPIB address of the device to trigger. If `address = NOADDR` then all Listeners already addressed are triggered.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** When this call is executed, the GPIB GET (Group Execute Trigger) message is sent to the specified device.

To trigger several GPIB devices, use `TriggerList`.

**Example** This example triggers a device connected to board 0 whose primary GPIB address is 6 and secondary address is 12.

```
BASIC  CALL Trigger (0, 6 + 256*12)

C      Trigger (0, MakeAddr (6, 12));
```

## TriggerList

**Purpose** Triggers multiple GPIB devices

**Syntax**

BASIC `CALL TriggerList (board%, addresslist%())`

C `void TriggerList(int board, int addresslist[])`

**Parameters** `board` is an integer which identifies the GPIB board to be used for this operation. In most applications, this value is 0.

`addresslist` is an array of GPIB addresses, terminated by the value `NOADDR`. These addresses identify the devices to be triggered. If this array contains only `NOADDR` (in C a NULL value is passed), all previously addressed listeners are triggered.

**Returns** `ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** Use `Trigger` to trigger only one device.

**Example** This example triggers two devices simultanously. The devices are connected to board 0 and are at GPIB addresses 6 and 7.

```
BASIC   DIM addresslist%(3)
        addresslist%(0) = 6
        addresslist%(1) = 7
        addresslist%(2) = NOADDR
        CALL TriggerList(0, addresslist())

C       short addresslist[3] = {6, 7, NOADDR};
        TriggerList(0, addresslist);
```

## WaitSRQ

**Purpose** Wait until a device asserts SRQ.

**Syntax**

BASIC `CALL WaitSRQ (board%, result%)`

C `WaitSRQ(int board, short *result)`

**Parameters** `board` is an integer which identifies the GPIB board to use for this operation. In most applications, this value is 0.

**Returns** `result` indicates whether or not an SRQ occurred. If an SRQ occurs before the timeout expires, `result` = 1. Otherwise, `result` = 0.

`ibsta` will contain a 16-bit status word as described in Appendix B.

`iberr` will contain an error code, if an error occurred.

**Usage Notes** This call suspends operation until a device requests service or a timeout occurs. Follow this call with a FindRQS call to determine which device needs service.

**Example** Wait for a GPIB device to request service and then ascertain if device 6 or 7 requires service.

BASIC

```
DIM addresslist%(3), resultlist(2)
addresslist%(0) = 6
addresslist%(1) = 7
addresslist%(2) = NOADDR
CALL WaitSRQ(0, result%)
IF result% = 1 then
    CALL FindSRQ(0, addresslist%(),resultlist%())
END IF
```

C

```
Short addresslist[3] = {6,7,NOADDR};
short resultlist[3];
short result;
WaitSRQ (0,&result);
if (result == 1)
    {FindSRQ (0, addresslist, resultlist}
```

# Appendix A – Multiline Interface Messages

| HEX | DEC | ASCII | MSG | HEX | DEC | ASCII | MSG |
|---|---|---|---|---|---|---|---|
| 00 | 0 | NUL | | 20 | 32 | SP | MLA0 |
| 01 | 1 | SOH | GTL | 21 | 33 | ! | MLA1 |
| 02 | 2 | STX | | 22 | 34 | “ | MLA2 |
| 03 | 3 | ETX | | 23 | 35 | # | MLA3 |
| 04 | 4 | EOT | SDC | 24 | 36 | $ | MLA4 |
| 05 | 5 | ENQ | PPC | 25 | 37 | % | MLA5 |
| 06 | 6 | ACK | | 26 | 38 | & | MLA6 |
| 07 | 7 | BEL | | 27 | 39 | ‘ | MLA7 |
| 08 | 8 | BS | GET | 28 | 40 | ( | MLA8 |
| 09 | 9 | HT | TCT | 29 | 41 | ) | MLA9 |
| 0A | 10 | LF | | 2A | 42 | * | MLA10 |
| 0B | 11 | VT | | 2B | 43 | + | MLA11 |
| 0C | 12 | FF | | 2C | 44 | ‘ | MLA12 |
| 0D | 13 | CR | | 2D | 45 | - | MLA13 |
| 0E | 14 | SO | | 2E | 46 | > | MLA14 |
| 0F | 15 | SI | | 2F | 47 | / | MLA15 |
| 10 | 16 | DLE | | 30 | 48 | 0 | MLA16 |
| 11 | 17 | DC1 | LLO | 31 | 49 | 1 | MLA17 |
| 12 | 18 | DC2 | | 32 | 50 | 2 | MLA18 |
| 13 | 19 | DC3 | | 33 | 51 | 3 | MLA19 |
| 14 | 20 | DC4 | DCL | 34 | 52 | 4 | MLA20 |
| 15 | 21 | NAK | PPU | 35 | 53 | 5 | MLA21 |
| 16 | 22 | SYN | | 36 | 54 | 6 | MLA22 |
| 17 | 23 | ETB | | 37 | 55 | 7 | MLA23 |
| 18 | 24 | CAN | SPE | 38 | 56 | 8 | MLA24 |
| 19 | 25 | EM | SPD | 39 | 57 | 9 | MLA25 |
| 1A | 26 | SUB | | 3A | 58 | : | MLA26 |
| 1B | 27 | ESC | | 3B | 59 | ; | MLA27 |
| 1C | 28 | FS | | 3C | 60 | < | MLA28 |
| 1D | 29 | GS | | 3D | 61 | = | MLA29 |
| 1E | 30 | RS | | 3E | 62 | > | MLA30 |
| 1F | 31 | US | | 3F | 63 | ? | UNL |

| HEX | DEC | ASCII | MSG | HEX | DEC | ASCII | MSG |
|---|---|---|---|---|---|---|---|
| 40 | 64 | @ | MTA0 | 60 | 96 | ‘ | MSA0,PPE |
| 41 | 65 | A | MTA1 | 61 | 97 | a | MSA1,PPE |
| 42 | 66 | B | MTA2 | 62 | 98 | b | MSA2,PPE |
| 43 | 67 | C | MTA3 | 63 | 99 | c | MSA3,PPE |
| 44 | 68 | D | MTA4 | 64 | 100 | d | MSA4,PPE |
| 45 | 69 | E | MTA5 | 65 | 101 | e | MSA5,PPE |
| 46 | 70 | F | MTA6 | 66 | 102 | f | MSA6,PPE |
| 47 | 71 | G | MTA7 | 67 | 103 | g | MSA7,PPE |
| 48 | 72 | H | MTA8 | 68 | 104 | h | MSA8,PPE |
| 49 | 73 | I | MTA9 | 69 | 105 | i | MSA9,PPE |
| 4A | 74 | J | MTA10 | 6A | 106 | j | MSA10,PPE |
| 4B | 75 | K | MTA11 | 6B | 107 | k | MSA11,PPE |
| 4C | 76 | L | MTA12 | 6C | 108 | l | MSA12,PPE |
| 4D | 77 | M | MTA13 | 6D | 109 | m | MSA13,PPE |
| 4E | 78 | N | MTA14 | 6E | 110 | n | MSA14,PPE |
| 4F | 79 | O | MTA15 | 6F | 111 | o | MSA15,PPE |
| 50 | 80 | P | MTA16 | 70 | 112 | p | MSA16,PPD |
| 51 | 81 | Q | MTA17 | 71 | 113 | q | MSA17,PPD |
| 52 | 82 | R | MTA18 | 72 | 114 | r | MSA18,PPD |
| 53 | 83 | S | MTA19 | 73 | 115 | s | MSA19,PPD |
| 54 | 84 | T | MTA20 | 74 | 116 | t | MSA20,PPD |
| 55 | 85 | U | MTA21 | 75 | 117 | u | MSA21,PPD |
| 56 | 86 | V | MTA22 | 76 | 118 | v | MSA22,PPD |
| 57 | 87 | W | MTA23 | 77 | 119 | w | MSA23,PPD |
| 58 | 88 | X | MTA24 | 78 | 120 | x | MSA24,PPD |
| 59 | 89 | Y | MTA25 | 79 | 121 | y | MSA25,PPD |
| 5A | 90 | Z | MTA26 | 7A | 122 | z | MSA26,PPD |
| 5B | 91 | [ | MTA27 | 7B | 123 | { | MSA27,PPD |
| 5C | 92 | \ | MTA28 | 7C | 124 | \| | MSA28,PPD |
| 5D | 93 | ] | MTA29 | 7D | 125 | } | MSA29,PPD |
| 5E | 94 | ^ | MTA30 | 7E | 126 | ~ | MSA30 |
| 5F | 95 | _ | UNT | 7F | 127 | DEL | MSA0 |

**Message definitions (MSG column):**

| | | | | | |
|---|---|---|---|---|---|
| DCL | Device Clear | MTA*n* | My Talk Address | SPD | Serial Poll Disable |
| GET | Group Execute Trigger | PPC | Parallel Port Configure | SPE | Serial Port Enable |
| GTL | Go To Local | PPD | Parallel Poll Disable | TCT | Take Control |
| LLO | Local Lockout | PPE | Parallel Port Enable | UNL | UnListen |
| MLA | My Listen Address *n* | PPU | Parallel Port Unconfigure | UNT | UnTalk |
| MSA | My Secondary Address | SDC | Selected Device Clear | | |

# Appendix B – IBSTA

Every GPIB library routine returns a 16-bit status word to the variable `ibsta`. This status word describes the current condition of the GPIB bus lines and the GPIB Interface Board. By examining the status word, the programmer may determine what path the application program is to take.

Note that the mnemonics used to describe each bit of the status word are defined within the header file for each language. For example, if you are programming in QuickBASIC, the following two calls are equivalent:

```
IF IBSTA% AND TIMO THEN PRINT "TIMEOUT ERROR"
IF IBSTA% AND &H8000 THEN PRINT "TIMEOUT ERROR"
```

The status word contains 16-bits. If a bit equals 1 (set), the corresponding condition is true. Likewise, if a bit equals 0, then the corresponding condition has not occurred. The status word is of the following format:

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|---|
| | ERR | TIMO | END | SRQI | RQS | EEVENT | SPOLL | CMPL |
| Hex Value | 8000 | 4000 | 2000 | 1000 | 800 | 400 | 200 | 100 |

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | LOK | RREM | CIC | AATN | TACS | LACS | DTAS | DCAS |
| Hex Value | 80 | 40 | 20 | 10 | 8 | 4 | 2 | 1 |

Where:

| Bit | Description |
|---|---|
| ERR (EERR) | **GPIB Error**. If this bit = 1, an error has occurred during the call. An error code describing the exact error is returned to the `iberr` variable. See Appendix C - IBERR for more information. ERR is cleared following any call that does not result in an error. (EERR in Basic)<br>Check for errors after each call. If an undetected error occurs early in your program, it may not be apparent until later in the program, when it is more difficult to isolate. |
| TIMO | **Timeout Error**. If this bit = 1, a time-out has occurred. Some of the conditions which may result in this are:<br>▪ A synchronous I/O function exceeds the programmed timeout.<br>▪ An `ibwait` has exceeded the time limit value.<br>▪ This bit is cleared (set to 0) during all other operations.<br>Note that different timeout periods may be set for each device. You can set the timeout values either in CBCONF or in your program by using the `ibtmo` function. |
| END (EEND) | **END or EOS Detected**. If this bit = 1, EOI has been asserted or an EOS byte has been detected. If the GPIB Interface board has been programmed via an `ibgts` to perform shadow handshaking, any other routine can set this bit to one.<br>This bit is cleared (set to 0) whenever an I/O operation is initiated.<br>Note: This is EEND in Basic or Pascal. |
| SRQI | **SRQ Interrupt Received**. If this bit = 1, a device or Controller is requesting service. This bit is set upon the following conditions:<br>▪ The GPIB Interface Board is the Active Controller.<br>▪ The GPIB SRQ line is asserted.<br>▪ Automatic serial poll capability is disabled.<br>▪ This bit is cleared (= 0) upon the following conditions:<br>▪ The GPIB Interface Board is no longer the Active Controller.<br>▪ The GPIB SRQ line is unasserted. |
| EEVENT | **Event Occurred**. If this bit =1, then an event occurred. (This function is not implemented in the GPIB library. This description is included for compatibility only.) |
| SPOLL | **Serial Poll**. If this bit = 1, the board has been serially polled. This can only occur when the board is not the controller. |

| Bit | Description |
|---|---|
| RQS | **Device Requesting Service**. If this bit = 1, a device is requesting service. RQS is set in the status word whenever the hex 40 bit is asserted in the serial poll status byte of the device. The serial poll that obtained the status byte may have been the result of an `ibrsp` or the poll may have been automatically performed if automatic serial polling is enabled. RQS is cleared when an `ibrsp` reads the serial poll status byte that caused the RQS. An `ibwait` on RQS should only be done on devices that respond to serial polls. |
| CMPL | **I/O Completed**. When set, this bit indicates that all I/O operations have been completed. CMPL is cleared while I/O is in progress. |
| LOK | **Lockout State**. Indicates whether the board is in a lockout state. While LOK is set, the `EnableLocal` routine or `ibloc` function is inoperative for that board. LOK is set whenever the GPIB board detects the Local Lockout (LLO) message has been sent either by the GPIB board or another Controller. LOK is cleared when the Remote Enable (REN) GPIB line becomes unasserted by the system controller. |
| RREM | **Remote State**. If this bit = 1, the GPIB Interface Board is in the remote state (i.e, the REN line has been asserted and the Board has been addressed as a listener.). This bit is cleared when one of the following occurs:<br>▪ REN is unasserted.<br>▪ The GPIB Interface Board has been addressed as a Listener and receives a GTL (Go to Local) command.<br>▪ IBLOC is called while the LOK bit = 0. |
| CIC | **Controller-In-Charge**. If this bit = 1, it indicates that the GPIB Interface Board is the Active Controller. This bit is set upon the following conditions:<br>▪ If the board is the system controller and `ibsic` or `SendIFC` is executed.<br>▪ Control is passed to the GPIB Interface Board.<br>▪ This bit is cleared whenever the GPIB board detects Interface Clear (IFC) from the system controller, or when the GPIB board passes control to another device. |
| AATN | **Attention**. If this bit = 1, ATN is asserted. Likewise, if this bit = 0, the ATN line is unasserted. |
| TACS | **Talker**. If this bit = 1, the GPIB Interface Board has been addressed as a talker. This bit is cleared when one of the following occurs:<br>▪ The UNT command is sent.<br>▪ The GPIB Interface Board is sent its listen address.<br>▪ Another talker is addressed.<br>▪ IFC is asserted. |
| LACS | **Listener**. If this bit =1, the GPIB Interface Board has been addressed as a Listener. It can also be set if the GPIB Interface Board shadow handshakes (as a result of an `ibgts`). This bit is cleared whenever one of the following occurs:<br>▪ The GPIB Interface Board receives an UNL (Unlisten) command.<br>▪ The GPIB Interface Board is addressed as a talker.<br>▪ `ibgts` is called disabling shadow handshaking. |
| DTAS | **Device Trigger Status**. If this bit = 1, a GET (Group Execute Trigger) command has been detected. This bit is cleared in the status word on any call immediately following an `ibwait` if the DTAS bit is set in the `ibwait` mask parameter. |
| DCAS | **Device Clear State**. If this bit = 1, a DCL (Device Clear) or SDC (Selected Device Clear) command has been received by the GPIB Interface Board. The bit is cleared on any call immediately following an `ibwait` call if the DCAS bit was set in the `ibwait` mask parameter, or on any call immediately following a read or write.<br>Some of the status word bits can also be cleared under the following circumstances:<br>▪ If `ibonl` is called, the `EEND`, `LOK`, `RREM`, `CIC`, `TACS`, `LACS`, `DTAS`, and `DCAS` bits are cleared.<br>▪ If an ENEB or EDVR error is returned (See Appendix C - IBERR for more information.), all of the status word bits *except EERR* are cleared. |

# Appendix C – IBERR

If the EERR bit in the status word (ibsta) has been set (= 1), an error code describing the exact error is returned to the iberr variable. Table C-1 lists the possible GPIB error codes, the corresponding mnemonic, and a brief explanation. Note that the mnemonics are defined within the header files for each language. This allows you to use the mnemonic in place of the error code value. Detailed explanations of each error and possible solutions are listed after the table.

Table C-1. Error codes

| Error Code | | Description |
|---|---|---|
| **Decimal** | **Mnemonic** | |
| 0 | EDVR | Driver Error |
| 1 | ECIC | Specified GPIB Interface Board is not the Active Controller |
| 2 | ENOL | No present listening devices |
| 3 | EADR | GPIB Interface Board has not been addressed properly |
| 4 | EARG | Invalid argument specified |
| 5 | ESAC | Specified GPIB interface board is not the system controller |
| 6 | EABO | I/O operation aborted (time-out) |
| 7 | ENEB | Non-existent GPIB board specified |
| 10 | EOIP | Routine not allowed during asynchronous I/O operation |
| 11 | ECAP | No capability for operation |
| 12 | EFSO | File System error |
| 14 | EBUS | Command byte transfer error |
| 15 | ESTB | Serial poll status byte lost |
| 16 | ESRQ | SRQ stuck in ON position |
| 20 | ETAB | Table problem |
| 247 | EINT | No interrupt configured on board |
| 248 | EWMD (16-bit only) | Windows is not in Enhanced mode |
| 249 | EVDD (16-bit only) | CBGPIB.386 is not installed |
| 250 | EOVR (16-bit only) | Buffer overflow |
| 251 | ESML (16-bit only) | Two library calls running simultaneously |
| 252 | ECFG | Board type does not match GPIB.CFG |
| 253 | ETMR (16-bit only) | No Windows timers available |
| 254 | ESLC (16-bit only) | No Windows selectors available |
| 255 | EBRK (16-bit only) | Ctrl-Break pressed, exiting program |

**EDVR — Driver error**

Cause: A board or device is not installed or configured properly. This error is returned when a device or board that is passed to ibfind cannot be found, or when a board index passed to ibdev cannot be found. ibcntl will contain an error code to help further identify the problem.

Solution:
- Call ibdev to open a device without using its symbolic name.
- Configure each board and device using CBCONF before using them as parameters to ibfind.
- Include the unit descriptor that is returned from ibfind or ibdev as the first parameter in the function. Verify that the value of the variable before the failing function is not corrupted.

**ECIC — specified GPIB interface board is not CIC**

Cause: Many routines require that the GPIB interface board is the Controller-In-Charge. These include: ibcmd, ibln, ibrpp, Send, Receive, for example.

Any routines which manipulate the GPIB ATN, EOI, or REN lines

Solution: Make sure that the GPIB interface board is the Controller-In-Charge

### ENOL — no listening device(s)

Cause: The routine detected no listeners.

Solution: Verify the following:

- Make sure that a device has been addressed properly.
- Check that at least two-thirds of the devices on the GPIB bus are turned on, including the specified device.
- Make sure that all connections are secure.
- Verify the device(s) GPIB address.
- Make sure that the device was properly configured with the `CBCONF` configuration program.

### EADR — GPIB interface board not addressed

Cause: The GPIB interface board has not been addressed.

Solution: Call `ibcmd` and address the board.
If you are calling `ibgts`, with shadow handshaking enabled, call `ibcac`.

### EARG — invalid argument

Cause: An invalid parameter has been provided to a routine.

Solution: Check syntax and range of parameters. See Chapter 4 GPIB 488.1 Library Reference and Chapter 5 GPIB 488.2 Library Reference.

### ESAC — board is not the system controller

Cause: Routine requires that the GPIB interface board is the system controller.

Solution: Configure the board to be the system controller. Run your configuration utility (`CBCONF`) or call `ibrsc`.

### EABO — I/O operation aborted

Cause: I/O operation aborted. (time-out)

Solution: Check that the device is powered on.
Verify proper cable connections.

### ENEB — non-existent GPIB board

Cause: GPIB board is not recognized.

Solution: Make sure that GPIB board settings and configuration setup parameters agree.

### EOIP — function not allowed while I/O is in progress

Cause: An illegal call is made during an asynchronous I/O operation.

Solution: Only `ibstop`, `ibwait`, and `ibonl` calls are allowed during asynchronous I/O operations. The driver must be resynchronized by calling one of the following:

- `ibwait` (mask contains `CMPL`) - The driver and application are synchronized.
- `ibstop` - The asynchronous I/O is canceled, and the driver and application are synchronized.
- `ibonl` - The asynchronous I/O is canceled, the interface is reset, and the driver and application are synchronized.
- Re-synchronization is successful if a CMPL is returned to `ibsta`.

### ECAP — no capability for operation

Cause: A call attempts to use a capability which is not supported by the GPIB board.

Solution: Don't use the call; upgrade your GPIB board

### EFSO — file system error

Cause: A problem was encountered while performing a file operation.

Solution: Verify the following:

- Make sure that you specified the correct filename.
- Check the spelling and the path.
- If you need more room on the disk, delete some files.
- Verify that you did not assign a name to a device which is already used by a file (using your `CBCONF` configuration program).

**EBUS — command byte transfer error**

Cause: A GPIB bus error occurs during a device function.

Solution: Determine which device, if any, is abnormally slow to accept commands and fix the problem with the device.

Lengthen the assigned time limit using `ibtmo` or `IBCONF`.

**ESTB — serial poll status byte(s) lost**

Cause: One or more serial poll status bytes received during an automatic serial poll was lost.

Solution: Call `ibrsp` more frequently to read the status bytes. Ignore the ESTB error.

**Note**: This error occurs only during `ibrsp` functions.

**ESRQ — SRQ in "ON" position**

Cause: A wait for an RQS can not occur because the GPIB SRQ line is ON.

Solution: Verify the following:

- Ignore the ESRQ until all devices are found.
- Make sure an `ibfind` is called to open all devices on the bus capable of asserting SRQ.
- Test that each device is unasserting SRQ.
- Check the cabling. Make sure that all devices are attached and the connectors are seated properly.

**ETAB — table problem**

Cause: There was a problem with a table used in a `FindLstn` or `FindRQS`.

Solution: If the error occurs during a `FindLstn`, this is a warning and not an error. Ignore the warning or make the buffer larger.

If the error occurs during a `FindRQS`, then none of the specified devices are requesting services. Verify that the device list contains the addresses of all on line devices.

**EINT — no interrupt level configured**

Cause: Your routine requires an interrupt and no interrupt level is configured for the board.

Solution: Use a routine that doesn't require an interrupt, or configure an interrupt level.

**EWMD — Windows not in enhanced mode (16-bit only)**

Cause: The Windows GPIB Library can only run in Windows Enhanced Mode, and Windows is currently running in a different mode.

Solution: Restart Windows in enhanced mode, or upgrade to a newer version of Windows.

**EVDD — CBGPIB.386 is not installed (16-bit only)**

Cause: The Windows GPIB library requires the CBGPIB.386 device driver to be installed, and it isn't.

Solution: Edit your Windows `SYSTEM.INI` file. It is normally located in the \windows directory. Add the following entry to the section that begins with [`386Enh`]

```
device=\gpib\cbgpib.386
```

If your software was not installed in the default `\gpib` directory, change that line to the appropriate directory.

**EOVR — Buffer overflow (16-bit only)**

Cause: A buffer was not large enough to hold the data.

Solution: Increase the size of the buffer.

**ESML — Library calls running simultaneously (16-bit only)**

Cause: The GPIB library can only execute one function at a time, and an attempt was made to call a GPIB routine while another routine was still executing. The most common causes are that more than one GPIB program is being executed or that GPIB routines are being called from timer event handlers.

Solution: If more than one GPIB program is running, then stop one of them. If you are calling GPIB routines from within Windows timer event handlers, add code to detect and prevent the problem.

A common solution is to use a semaphore variable. In your main code set a variable to some known value before you begin executing GPIB routines, and clear it when you finish. In your timer event handler, only call the GPIB routine if the semaphore is cleared. Refer to the `VBDEMO` example program's use of the `GPIBCallInProgress` variable for a demonstration of how to use this technique.

**ECFG — board type does not match GPIB.cfg**

Cause: The board type specified in the GPIB.CFG file is different than the installed board.

Solution: Run the `CBCONF` configuration program and set the `Board Type` to the correct board type.

**ETMR — No Windows timers available (16-bit only)**

Cause: Windows has a limited number of system timers. The GPIB library requested a timer and Windows reported that there were none left.

Solution: Stop any running Windows programs that you are not using.

**ESLC — No Windows selectors available (16-bit only)**

Cause: No memory selectors are available.

Solution: Close any open programs to free up more memory.

**EBRK — Ctrl-Break pressed, exiting program (16-bit only)**

Cause: The program was terminated by the user pressing the Control-Break key.

Solution: --

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